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MENINGEAL FIBROBLASTOMAS OF THE CEREBRUM

A CLINICOPATHOLOGIC ANALYSIS OF SEVENTY-FIVE CASES

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PHILADELPHIA

Despite an ever widening knowledge of the life cycle of tumors of the brain, much remains that is still obscure from both the clinical and the pathologic point of view. This is particularly true of the meningeal fibroblastomas—tumors which, by virtue of their slow growth, often give rise to very few symptoms in the early and even in the later stages of their expansion. Their diagnosis is often difficult. It is because of this, as well as a desire to know more about their clinical expression and histologic structure, that we have reviewed a series of seventy-five cases of meningeal fibroblastomas of the cerebrum which have been observed by us in the clinic and laboratory of the Hospital of the University of Pennsylvania.

We have not ventured in this contribution a comprehensive presentation of the subject of cerebral fibroblastoma. We have made no reference to the clinical experience of others, but have been content with the exposition of the essential features of the cases observed in our own clinic. We have used clinical records freely as illustrations. These we believe are both informative and instructive and add not a little to the value of the contribution. We have limited the scope of the article to the clinical and pathologic aspects of the subject under consideration and reserve the surgical problem for future publication.

LOCATION OF FIBROBLASTOMAS OVER THE CONVEXITIES

The majority of our tumors of this type were located in the anterior half of the cerebrum. A glance at table 1 will show that fifty-eight of our seventy-five cases, or 77 per cent, were found in the frontal, precentral or temporal areas of the brain.

From the Neurosurgical Service and the Neurosurgical Laboratory in the Hospital of the University of Pennsylvania.

Read at the Fifty-Eighth Annual Meeting of the American Neurological Association, Atlantic City, N. J., June 6, 1932.

If tumors in the precentral area are grouped with frontal tumors, then forty of the fifty-eight anteriorly placed tumors are in the frontal region (fig. 1). This area, therefore, seems to be a favorite site for the fibroblastoma. Its preponderance over the anterior half of the convexities and particularly in the frontal area is probably more than accidental, but the reason for this predilection is not altogether clear. If we assume that the arachnoid clusters are more numerous along the longitudinal sinus in its anterior half and along the cerebral sinuses in approximation to the sylvian fissure, we can explain this predilection to our satisfaction. But there is no evidence to this effect. On the other hand, if we accept the relationship between these tumors and the cell clusters in the arachnoid, an explanation is at hand. Tumors arising in the frontal, precentral and parietal areas, particularly, are prone to be attached to the falx. The same is likely true of tumors of the occipital lobe, but our records are not specific as to this. Tumors of the frontal lobe, in particular, are adherent to the falx; thirteen of our twenty-two tumors

TABLE 1.—*Location of Tumors*

Area	Number of Tumors
Frontal	22
Precentral	18
Temporal	18
Parietal	8
Occipital	9
Total	75

over the frontal convexities were attached to this membrane. The probabilities are that those tumors found in areas of the brain (frontal, precentral, parietal and occipital) which come in contact with the longitudinal sinus are apt to be attached to the falx. Sometimes this connection may not be readily apparent; at first the tumor appears to be quite removed from the falx, but when completely isolated, its origin in the falx is manifest.

No predilection for one convexity as compared with the other was found. The tumors were about equally divided over both hemispheres. In seven instances, however, we found tumors which straddled the midline and compressed both hemispheres. Some of these were particularly interesting clinically and will be referred to later.

GENERAL CONSIDERATIONS

In discussing the clinical phases of fibroblastomas, certain aspects may be taken up inclusive of the entire group, other aspects according to regional distribution. The aspects common to the whole group include the life history, convulsions, trauma, roentgenographic evidence, ocular phenomena and age of the patient.

Life History.—The date of origin or, if preferred, the duration of the period of tumor growth is necessarily a matter for speculation. Fibroblastomas are essentially slowly growing, and no doubt years elapse before there is the slightest inkling of the existence of a tumor. Five years, we should say, is not an unusual period, and unquestionably in many cases the life history of the tumor spans a much longer time. In two cases of the frontal lobe series there was a history of headache for ten years; in one case in which there was a tumor of the occipital lobe there had been "vomiting spells" for eleven years; in one case in which there was a tumor of the temporal lobe vision had been failing for ten years.

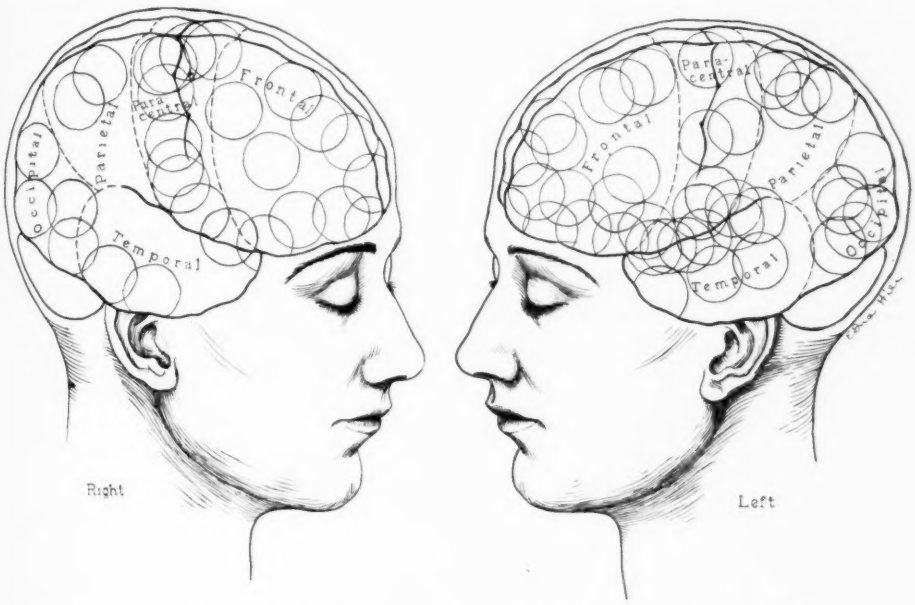

Fig. 1.—Views of the right and left sides, showing the distribution of the fibroblastomas over the brain. It will be seen that the majority are in the frontal area and on either side of the fissure of Rolando.

Convulsions.—These are not uncommon as initial symptoms; in four cases of tumor of the frontal lobe there had been general convulsions for two, four, five and eight years, respectively; in one case of precentral tumor, four years, and in two cases of occipital tumor, four and one year, respectively. In one case in which there was a tumor of the frontal lobe there were jacksonian seizures for seven years; in one in which there was a precentral tumor, for six years.

The longest period from the time of the first symptom to the date of operation was seventeen years. This patient suffered from petit mal.

In another case the length of the history extended over a period of ten years. The patient had a large calcified tumor in the midline, extending from the vault to the base. It was too firmly fixed and too densely calcified to be removed (fig. 2). This patient was followed for at least seven years after operation, during which time she returned to the clinic on two occasions; later she had an abdominal operation. But, as a matter of fact, all these illustrations are exceptions, and the question might well be asked whether in every instance the convulsion, headache or vomiting spell was originally of tumor origin. Generally speaking, in the vast majority of this series the first symptom did not appear until the first, second or third year preceding the operation.

Trauma.—The relationship of trauma to the origin of tumor has always been a moot question. A history of cranial trauma for a varying number of years prior to operation was recorded in fourteen

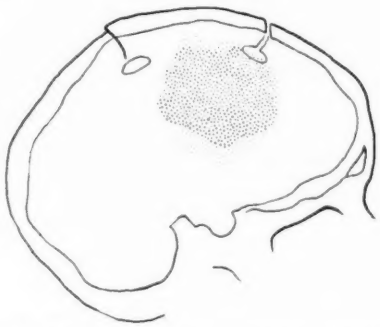

Fig. 2.—Schematic drawing of the roentgenogram, showing calcified portion of the tumor, extending from the vault to about half way to the base in the midline.

cases of this series: six in the frontal lobe series (twenty-six, twenty, sixteen, nine, seven and one year); three in the temporal lobe series (ten, three and one year), and three in the occipital lobe series (forty-eight, twenty-eight and two years). No doubt, in most of these cases the trauma was incidental.

Roentgenographic Evidence.—Of localizing value, there were five instances of calcification and ten of hyperostosis, 6 and 13 per cent, respectively. In one instance there was displacement of a calcified pineal gland. In every other case in which positive roentgenographic findings were recorded, the findings were indicative only of increased intracranial pressure, as given in table 2.

Because of its importance in differential diagnosis and of the extraordinary coincidence, we mention an enormous benign hyperostosis of the frontal bones in a patient with a fibroblastoma of the left frontal lobe (case 1). It was difficult at first to disassociate this tremendous

thickening of the frontal bones from some relationship with the tumor (fig. 3). But the process did not involve either the inner or the outer table; it was limited to the diploe and was no less dense than the diploic structures elsewhere. These characteristics, taken with the fact that the

TABLE 2.—*Roentgenographic Evidence of Increased Intracranial Pressure*

Signs	Cases
Convolutional markings	2
Enlarged vascular channels	2
Widening of sutures	1
Atrophy of dorsum sella	12
Erosion of clinoid processes	6
Enlarged pituitary fossa	2
Benign hyperostosis	1

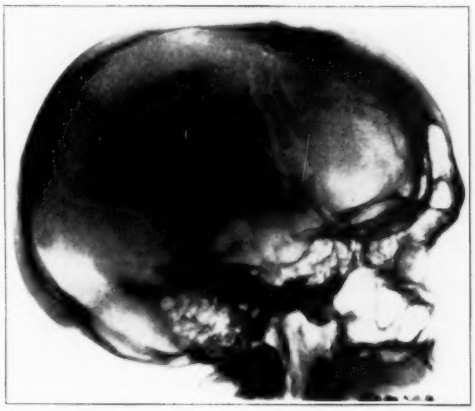

Fig. 3 (case 1).—Roentgenogram showing a benign bilateral hyperostosis associated with a fibroblastoma in the frontal region.

process was symmetrical and extended to the coronal suture, were sufficient to differentiate what Pancoast calls a benign hyperostosis from the hyperostosis of tumor origin.

CASE 1.—*A series of eight convulsions in three hours six days before admission. In the last eighteen months the patient had fallen twice; in the last twelve months speech and mental responses had been slower than normal. Roentgenographic findings: dorsum sellae rarefied, benign hyperostosis in the frontal region. The tumor in the left frontal lobe, close to the midline, arising from the falx, successfully removed.*

Clinical History.—Mrs. J. H. S., aged 53, was admitted to the neurosurgical service of the University Hospital on July 27, 1932. She had had a series of eight convulsions in three hours six days before. Previous to this she had been well, except that she had fallen twice in the past eighteen months, once down stairs. For a year her speech and mental responses had been slower, and she had been slower than usual in getting about. Often she had had headache, and had been

forced to stop and hold on to something because things went black before her. She had seemed absent-minded. Six days before admission she had the first convulsion. The convulsions were controlled by 8 grains (0.52 Gm.) of sodium phenobarbital given hypodermically. The attacks were described as typically epileptic, but there is no information as to whether they were jacksonian in type. She is said to have had weakness of the right arm and right side of the face after regaining consciousness following the attacks. Memory for recent events was impaired.

Examination.—Neurologic examination showed attention and memory to be very poor. There was questionable weakness of the right leg. A slight facial weakness was present on the right. There was possible aphasia.

There was no choking of the disks. The visual fields were contracted.

A roentgenogram showed that the dorsum sellae was rarefied. In the frontal region the skull was tremendously thickened. This thickening ran back to the level of the coronal suture. It did not involve the inner or the outer table, but was limited to the diploic portion of the bone. This showed a little less density than the diploic structure elsewhere. The appearance was not typical of a fibroblastoma.

TABLE 3.—*Incidence of Ocular Changes*

	Cases	Per Cent
Frontal tumors	12 of 22	59
Precentral tumors	3 of 18	16
Temporal tumors	9 of 18	55
Parietal tumors	1 of 8	12
Occipital tumors	5 of 9	44

Operation and Course.—A left frontal craniotomy was performed on July 29, 1932. A tumor was found in the left frontal lobe, close to the midline, arising from the falx, mostly undermining the cortex, but with a small surface presentation. It was completely removed.

The pathologic diagnosis was: meningeal fibroblastoma.

The patient made a surprisingly rapid recovery and left the hospital eight days after the operation.

Ocular Phenomena.—As an indication either of papilledema or of optic atrophy, mention is made of failing vision in thirty instances, as shown in table 3.

Papilledema was recorded in twenty-six cases and varied from 1 to 10 diopters. It seems that the higher degrees of choking were present in cases of tumor of the frontal lobe. Unequal choking was not a striking feature at all. There were several instances in which there was a difference of 0.5 or 1 diopter between the two sides, a difference of little practical moment, and only four instances in which the difference was most striking. In two cases in which there were tumors of the right temporal lobe the readings were: right, plus 2 diopters; left, plus 6 diopters, and right, plus 4 diopters; left, plus 1 diopter. In one case of tumor of the left parietal lobe, the readings were: right, plus 4 diopters and left, plus 7 diopters; and in one of tumor of the right frontal

lobe, they were: right, plus 4 diopters and left, plus 1 diopter. In this case the inequality of the papilledema was the only satisfying bit of evidence as to laterality.

In six of the eighteen cases of tumor of the temporal lobe, in one of tumor of the precentral lobe and in four of tumor of the occipital lobes there was a homonymous hemianopia.

There were four instances of exophthalmos, all in cases of tumor of the frontal lobe; five instances of corneal hypesthesia, in three cases of tumor of the frontal lobe and in two cases of tumor of the temporal lobe; three recorded cases of nystagmus, two in cases in which there were tumors of the frontal lobe and one in a case in which there was a tumor of the temporal lobe, and one instance of impaired convergence.

Age.—The localization of the tumor in a given case is an essential step in preparation for the operation. However, one is often asked by the patient or by the patient's family, before the operation, whether or not the tumor is operable. Sometimes the decision for or against exploration will hinge on the answer to this inquiry. Hence we are in the habit of expressing our opinion before the operation as to whether we are dealing with a tumor that is well encapsulated and extracerebral (fibroblastoma) or with a tumor that is intracerebral and nonencapsulated (glioma). Obviously, the prognosis of each as to life expectancy is as far apart as the poles. A factor of considerable practical moment in this determination is the age of the patient. The fibroblastoma is essentially a tumor of adult life; that is, of seventy-five fibroblastomas there were only six in patients under 20 years of age, 3, 6, 10, 11, 12 and 18 years, respectively. The average age was as follows:

Frontal lobe	33	years
Precentral lobe	38.7	years
Temporal lobe	39.1	years
Parietal lobe	35.7	years
Occipital lobe	42.2	years
Average	37.74	years

As a fact, the averages given are verified by the accompanying chart (fig. 4) in which it will be noted that the greatest number of cases (33 per cent) fall between the ages of 30 and 40, a lesser number between 40 and 50 and approximately the same number from 20 to 30 and from 50 to 60.

Regional Considerations.—Much has been written of the distinctive characteristics of tumors in various areas of the brain, but there is still opportunity for further enlightenment. Fibroblastomas in particular remain unrecognized for long periods of time and come to operation often when they have attained such a large size that an attempt at

surgical removal is both difficult and hazardous. Were it possible to recognize their presence before they attain such unwieldy proportions, our surgical problems would be much simplified. Often the presence of a tumor may not even be suspected by the attending physician for a long while, so insidious is the onset and so inconspicuous are the early symptoms. But by the time the patient reaches the neurosurgical clinic the tumor may be so large that the possibilities of its removal with safety are remote. This is illustrated in case 2, in which failure to recognize the significance of enlargement of the head eventually resulted in an unnecessary disaster.

CASE 2.—*A child with symptoms of over a year's duration, hydrocephalic but ambulant, and with so little disability that there was considerable doubt as to the location of the tumor until its localization was determined by ventriculography. At operation a huge inoperable tumor was found, straddling the midline, and filling almost the entire anterior fossa.*

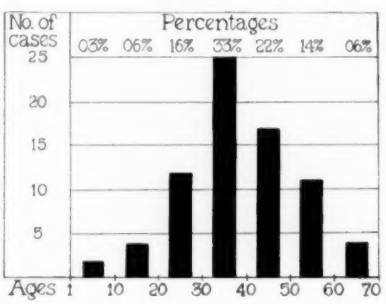

Fig. 4.—The preponderant incidence of fibroblastomas is between the ages of 30 and 40, a lesser incidence between 40 and 50 and a slightly lesser incidence between 20 and 30, and between 50 and 60.

Clinical History.—R. R., a girl, aged 3, was admitted to the neurosurgical service of the University Hospital on Jan. 21, 1928. There was a history of a normal instrumental delivery and of no abnormalities at birth. When 2 years of age, a year before admission, the mother noticed that the child stumbled when playing with other children, and that there was a certain amount of clumsiness which seemed limited to the right side. The head seemed to be increasing in size more rapidly than it should. The child's appetite was abnormally large. In December, 1927, three months before admission, the child began to complain of headaches and seemed restless. In January, 1928, there was an attack in which she did not fall or lose consciousness; it was characterized first by pallor and then by cyanosis of the face and rigidity of the body. There was a second attack of a similar nature a few days later, and after this the mother noticed more clumsiness and apparent weakness of the right arm and leg. The head was unusually large, and the biparietal diameter was more prominent on the left side.

Examination.—The neurologic status was as follows: In running or walking the child seemed to swing the right foot and to hold the right upper arm rather close to the side. Because of the age of the patient it was extremely difficult to

apply the ordinary tests for dysfunction, but it appeared as though there was inaccuracy in the right finger-to-nose test and none in the left. There was a suggestion of weakness in the distribution of the left facial nerve. The station with feet together was unsteady, although the patient would not close her eyes. Under the effect of dehydration the child did not seem to complain of so much headache, and there was less evidence of weakness on her right side.

On ophthalmic examination, the retinal vessels appeared somewhat tortuous, the margins of the disks were somewhat veiled, and were gray. There was papilledema of plus 1 diopter and a suggestion of postpapillitic atrophy was noted.

A roentgenogram of the skull showed it to be very thin, with widening of the sutures and enlargement of the pituitary fossa.

The protein content of the cerebrospinal fluid was within normal limits.

The left ventricle was enlarged, and the right was collapsed. The interpretation was: tumor of the right cerebral hemisphere.

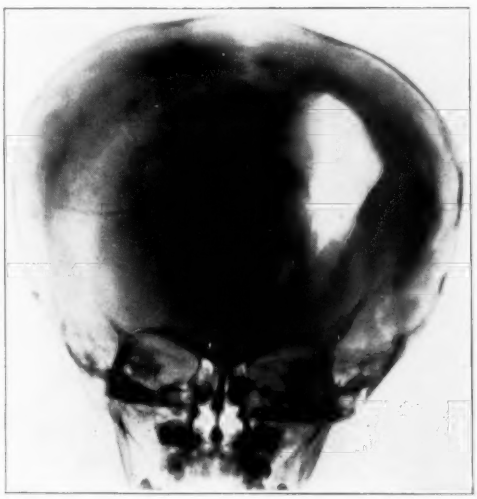

Fig. 5 (case 2).—Roentgenogram showing marked dilatation of the left ventricle and collapse of the right ventricle.

Ventriculography was performed. Withdrawal of 155 cc. of fluid from the left ventricle with the injection of 5 cc. of air was carried out. From the right ventricle only a few cubic centimeters of fluid escaped, and 5 cc. of air was injected. The interpretation of the films was: hemispheric tumor, right frontal (fig. 5).

Operation and Course.—The first stage of an exploratory craniotomy was performed on the right side on March 3, 1928, under ether anesthesia. A flap was reflected from the right frontoparietal region. Subdural tension was extreme. The dura over the frontal lobe was adherent to the cortex, and a firm tumor was felt on palpation. Because of the tremendous size of the tumor it was decided not to attempt its removal at this sitting.

The child survived this limited exploration for only twenty-four hours. There had been little loss of blood, and the patient had been given a transfusion immediately afterward.

Postmortem Examination.—The entire brain was removed, and a tumor of the right frontal lobe, weighing 230 Gm. was found. In the neighborhood of the uncinate gyrus there appeared to be a small subcortical cyst projecting toward the interpeduncular space. The right hemisphere was definitely larger than the left; there was no pressure cone about the medulla. The tumor straddled both frontal lobes, filled almost the entire anterior fossa and destroyed by compression a large part of both frontal areas.

The pathologic diagnosis was fibroblastoma (fig. 6).

Comment.—There were sufficient grounds for suspicion in this case at least a year before the child's admission. A ventriculogram at that time would have confirmed the diagnosis, and recognition of the tumor before it had reached such huge proportions would have made the surgical problems much simpler.

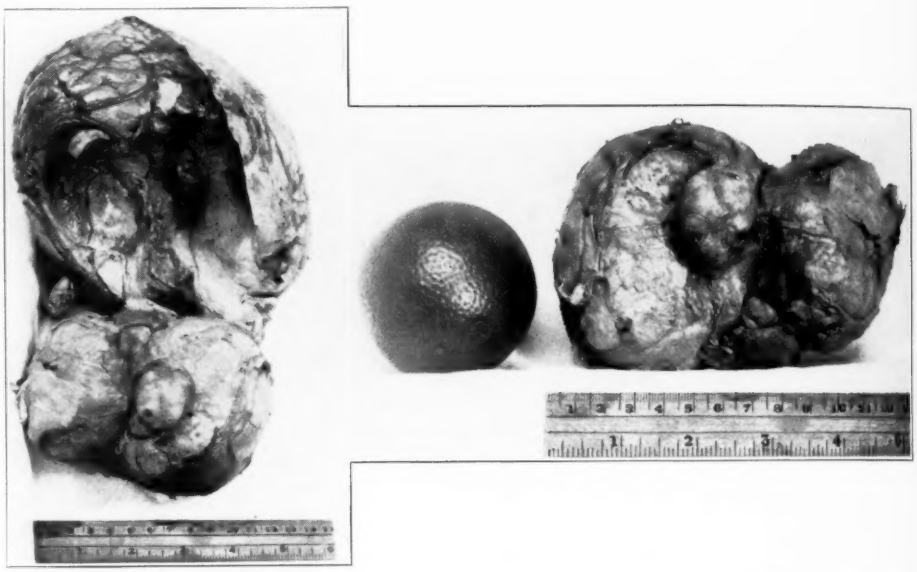

Fig. 6 (case 2).—On the left is a view of the brain from the front, showing a deep excavation formed by the tumor in both frontal lobes. On the right is the tumor mass; some idea of the size may be gained by comparison with an orange.

FRONTAL FIBROBLASTOMAS

In general, the diagnosis of tumors of the frontal lobes and their localization are often perplexing problems in the neurosurgical clinic. This observation is borne out by our experience in the twenty-two cases of our series. A glance at the histories and records reveals no signs or symptom common to them all, none which may be regarded as a common denominator of tumors in this location. Perhaps the only factor common to all is the evidence at some time or other of signs of increased intracranial pressure. In nineteen of our cases there was

either headache or evidence of failing vision. In this connection it is interesting to note in passing that in only five cases was vomiting recorded. In fourteen cases there was papilledema of high or low degree.

Weakness on one side of the body, when present, was a valuable aid in localization, though strictly speaking it indicated precentral rather than frontal involvement. The weakness appeared either by direct extension of the tumor to the precentral area or by compression of the corticospinal tracts in the centrum semiovale. In twelve cases localization was aided by the incidence of unilateral weakness without evidence of distortion of the visual fields, as in case 3.

CASE 3.—*Sudden attack thought to be apoplexy, with partial recovery, but later a marked spastic hemiparesis (arm and leg). No facial weakness, loss of vision, papilledema, increase in pressure or frontal lobe symptoms. The tumor, resembling a fibroblastoma en plaque, was successfully removed, and the patient made an uneventful recovery.*

Clinical History.—S. S., a man, aged 44, was admitted to the neurosurgical service of the University Hospital on Aug. 25, 1928, complaining chiefly of weakness and stiffness in the right arm and leg. In 1919, he had been struck on the left side of the forehead with a metal box. In July, 1926, he sustained another blow on the head, became unconscious and remained so for two days. He was said to have had a stroke. On recovery of consciousness he observed some stiffness of the right arm and leg which, however, disappeared in ten days. Since June, 1927, he had had several attacks of vomiting, and his disability had increased, although he could still walk with a cane. About the same time incontinence of urine developed; he did not realize that the bladder was full, nor was he conscious of voiding.

Examination.—On neurologic examination, the cranial nerves showed no involvement.

There were anesthesia of the right leg, except over the inner aspect of the heel, diminished pain and tactile sense in the left arm, and loss of temperature sense in the left arm and the left leg. The patient could not recognize objects held in the left hand—"astereognosis."

There was advanced spastic hemiparesis on the right. The dynamometer measured 35 on the right and 95 on the left. Occasional jerky movements of the left arm and leg were evident.

The left triceps, biceps and achilles tendon jerks were plus 4.

There were no field contractions, dimness of vision, choking of the disks or cut in the fields.

The pressure of the cerebrospinal fluid was 170 mm.; the Wassermann reaction was negative.

A roentgenogram suggested possibly a left frontal meningioma, though leontiasis and syphilis had to be excluded. There was a large area of increased density of bone in the left frontal region, beginning to extend into the right orbital plate.

The preoperative diagnosis was left frontal fibroblastoma.

Operation and Course.—A left frontal craniotomy was performed on Sept. 1, 1928, by Dr. F. C. Grant, with the patient under colonic anesthesia. A scalp flap with the base over the orbit was reflected. Perforations were made for the bone flap along the orbital ridge, but the thickness of the bone prevented the passage of the Gigli saws, and the intervening sections were removed with rongeur forceps.

The bone on the other two sides of the flap was not involved to any extent. The bone flap was reflected first and then removed. Immediately, the tumor was exposed. It was of a deep purplish color and extended from the midline outward and downward. The operation was a rather complicated one, and was described by Dr. Grant as follows:

"The patient had stood the operative procedure very well up to this time, but at this point his pulse became more rapid and he was given 500 cc. of citrated blood. I had all along intended to divide the operation into two stages, and while transfusion was being performed I removed more bone involved by the tumor around the lateral, frontal and mesial margins of the cranial opening. In tying off a number of large veins running to the tumor from the cortex, I found that the tumor involved the anterior end of the longitudinal sinus and the falx, extending to the dura and the surface of the opposite frontal lobe. I, therefore, tied the superior longitudinal sinus about one and one-half inches posterior to the crista galli and divided the falx.

"Following the transfusion, the patient's condition improved very much. Since so much of the dura had been torn and the tumor was soft, friable and vascular, it

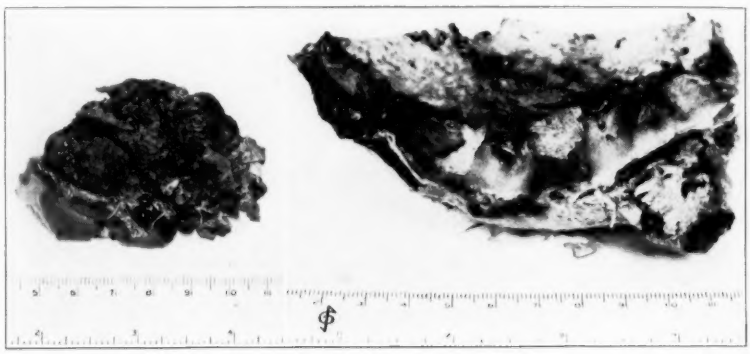

Fig. 7 (case 3).—The well defined tumor on the left was removed from the left frontal region. It was encapsulated, although the capsule appears broken. The surface was lobulated. The illustration on the right shows the bone overlying the tumor, which was markedly thickened and increased in density.

would have been difficult at a second stage to see the definition of the tumor. Hence, I decided to conclude the operation at this sitting. As I had secured almost all the blood vessels running from cortex to tumor, this was not a particularly difficult procedure. The tumor was not over 1.5 cm. in thickness and was spread out over the cortex as a meningioma en plaque. I removed the tumor, its dural attachment to the anterior end of the longitudinal sinus with the falx and as much of the dura over the right frontal lobe as I could easily reach.

"What remnants of tumor I could see in the right and left frontal regions were well cooked with the Bovie apparatus; complete hemostasis was obtained and the wound was closed carefully in layers, as usual, with silk.

"A drainage tube was introduced through a stab wound at the posterior end of the midline incision. The patient by this time was in a state of great shock, though conscious. While his pulse continued rapid for forty-eight hours, he gradually reacted from the shock and his condition was satisfactory."

The pathologic diagnosis was fibroblastoma (fig. 7).

The patient's convalescence was uneventful. He was discharged on Sept. 24, 1928. On Sept. 9, 1932, he still had a hemiplegia, but there were no signs of recurrence.

Often motor weakness, as in case 3, was noted by the patient and was one of his reasons for consulting a physician. The face alone was involved in three cases, the face and arm once, the arm alone once and the arm and leg in eight cases. Curiously enough, isolated weakness of one leg was never seen. Motor aphasia was present in five cases, three times being symptomatic and twice being detected in the routine examination.

The "mental symptoms" in cases of lesions of the frontal lobe, about which so much is heard, were by no means a constant feature. In fact, in only ten instances were there "mental symptoms" of any significance. In six of these, mental deterioration of varying degree was the outstanding feature. An inability to exert the usual degree of inhibition characterized some of them. One patient was unable to bear the presence of visitors and invariably left the room when visited by friends. Another, a Catholic priest, was always late for mass, though he made every effort to arrive in time. In one instance the mental disorder assumed the form of a true psychosis, characterized by a profound depression with typical psychic and motor retardation. In still another case, visual hallucinations were in evidence; this patient saw well formed figures, such as a fox and a man. She was not psychotic, but her mental capacity was much decreased. The type of hallucinatory experience which she had is much like that seen in patients with tumors of the temporal and occipital lobes, but without a cut in the visual field.

Visual hallucinations are not common in cases of tumors of the frontal lobe; in fact, we know of no previously published reports. They are usually found in parts of the brain through which the optic pathways run and are associated with cuts in the visual field. Their occurrence with tumor of the frontal lobe in a nonpsychotic patient is both interesting and important, indicating as it does that they may occur in areas unassociated directly with the optic nerve paths.

Thus, three fifths of the patients with tumors of the frontal lobe in this series were without mental symptoms. When present, as they were in ten instances, and especially when associated with other correlating signs, such as defective memory (seven instances) and loss of the sense of smell (six instances), the mental picture is more than suggestive of a lesion of the frontal lobe. In fact, in one instance it was the dominating and determining factor in the localization. In this case, with the exception of papilledema and almost complete loss of the sense of smell, neurologic examination gave entirely negative results. However, the friends and family of the patient, a physician, had noticed a decided

change in his habits for over a year. He had lost interest in his practice, had become inattentive and forgetful, and indulged in conversation on matters of sex, which was quite foreign to his previous habit. Moreover, he did not seem to grasp the seriousness of the situation. He exhibited not the slightest concern over his predicament and was willing to admit only that he needed a rest. At operation, performed on July 15, 1932, a fibroblastoma of huge proportions was found and removed. The tumor took origin from the olfactory groove (fig. 8).

In cases such as the following, in which the tumor is of large dimensions and encroaches on the parietal and temporal lobes, symptoms other than those specifically frontal will be present. In the case to be cited, in addition to failing memory and drowsiness, visual hallucinations, uncinate attacks, aphasia, failing vision and hemiparesis were present.

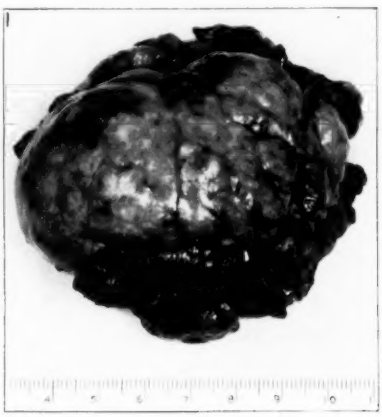

Fig. 8.—A large encapsulated and lobulated tumor of the frontal lobe.

CASE 4.—*A woman in the course of three years had become hemiparetic. Vision and memory were failing; she was inordinately drowsy and visual hallucinations and uncinate attacks had just developed. First operation, liberal decompression. Later, she became worse and an aphasia developed. At the second exploration, an enormous fibroblastoma was successfully removed. The tumor at no point appeared on the cortex and took origin from the inferior margins of the falx (fig. 9).*

Clinical History.—A. W., a woman, aged 32, was referred to the neurosurgical service of the University Hospital by Dr. T. H. Weisenburg, on March 20, 1931, complaining chiefly of weakness in the right arm and leg. In 1928, three years before, she had noticed weakness in the right arm. In 1929, two years before, the right leg had become weak. She had had occasional occipital headaches, severe at times though not associated with vomiting, and dull aching pains in the muscles of the right arm. Memory was not as good as it had been, and her vision was failing. She could read only the headlines in the paper. She felt drowsy at times, fell asleep easily, and went to bed early, getting up late. For the past two weeks she had had uncinate attacks, with a disagreeable sense of something burning.

Examination.—Neurologic examination showed: (1) a bilateral absence of the sense of smell and olfactory hallucinations which the patient believed were right-sided; (2) slight weakness of the external rectus, and (3) tinnitus.

There was pain on movement of the right shoulder.

Right hemiparesis, not involving the face, was present.

The triceps and biceps tendon jerks were plus 3 on both sides; the patellar tendon reflex was plus 3 on the right and plus 4 on the left.

Vision in the left eye was 6/6; that in the right eye, 6/12; the margins of disks were fluffy; there was papilledema of plus 2 diopters; the fields showed enlarged blind spots.

The globulin of the cerebrospinal fluid was 0.92 mg.; the pressure was 320 mm.

A roentgenogram showed the dorsum sellae atrophied, more on the left side.

The preoperative diagnosis was left frontoparietal tumor.

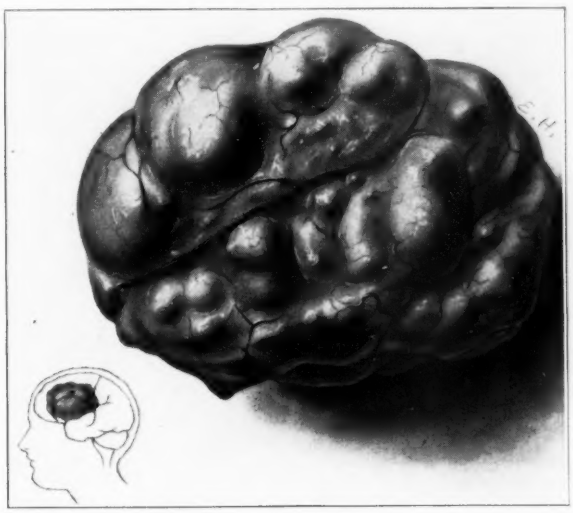

Fig. 9 (case 4).—A large encapsulated tumor in the left frontoparietal region. The insert in the corner shows the relative position of the neoplasm.

First Operation and Course.—Exploratory craniotomy and decompression were performed on March 28, 1931, under avertin anesthesia. A liberal flap was reflected to expose the frontal and parietal lobes. Just in front of the upper portion of the rolandic fissure the convolutions were flattened, soft in consistency and of a muddy yellow color. We presumed that we were dealing with a subcortical glioma. During this inspection the brain became intensely swollen and edematous. Manifestly, the bone of the flap had to be removed before the flap could be closed. When this was done it was not thought wise at this sitting to continue the exploration.

Between the time of discharge on April 8, 1931, and readmission on May 19, 1932, the patient had returned from time to time for review. We were under the impression that she had a large subcortical glioma and had at first decided to be content with the liberal decompression. However, in the interval the paralysis of the arm became complete and aphasia developed, a source of great distress. Accordingly, she was readmitted to the hospital for a second exploration.

Second Operation and Course.—An exploratory craniotomy on the left was performed on May 23, 1932, under avertin anesthesia. The tumor was found and removed. The original flap was reflected, and from the notes of the first operation we knew about where the tumor was approaching the surface. With the electrical unit the tumor was uncovered about 2 cm. below the surface. Little by little the tumor was mobilized, first on one side and then on the other; it seemed to lie beneath the parietal lobe and to extend well forward into the frontal lobe and undermined the temporal lobe. Finally, the entire tumor, with the exception of a single nubbin, was removed in toto. The nubbin was attached to the under margin of the falx and extended somewhat to the opposite side. On removal, the tumor weighed 216 Gm. and measured 10 by 9 by 5 cm. As we suspected, it proved to be a fibroblastoma, although at no point had the tumor come to the surface.

The pathologic diagnosis was fibroblastoma.

At the time of writing the patient was convalescent from the operation. Three days after the operation she began to be able to use words. The prognosis as to the recovery of speech thus far seems excellent.

TABLE 4.—*Symptoms in Twenty-Two Cases of Fibroblastoma of the Frontal Lobe*

1. Signs of Increased Intracranial Pressure		4. Neighborhood Symptoms	
Choked disk	14	Hemiparesis	8
Headache	19	Hemiplegia	4
Somnolence	2	Tremors	1
Vomiting	5	Facial weakness	9
Failing vision	12	Exaggerated reflexes	10
General convulsions	4	Hemianesthesia	1
		Impaired sense of position	2
2. Roentgenographic Evidence		Ataxia	2
Hyperostosis	5	Incoordination	1
Displaced pineal gland	1	Aphasia	5
Widened sutures	1	Nystagmus	2
Atrophy of dorsum sellae	8	Exophthalmos	4
Erosion of clinoid processes	2	Corneal anesthesia	3
Enlarged pituitary fossa	2	Focal convulsions	2
		Hallucinations	1
3. Focal Symptoms		Vertigo	3
Mental impairment	6	Tinnitus	2
Change in personality	2	Uncinate attacks	4
Loss of memory	2	Involvement of cranial nerves (V, XI, XII)	6
Anosmia	2		

Comment.—In this record, as in a number of others of our series, there is a symptom complex that comprehends at least three lobes, frontal, temporal and precentral. It is difficult, therefore, to portray a picture which points exclusively to one lobe or another, or to designate a given case as belonging to one group or another. If one were influenced wholly by the sequence of events, as recorded in the history, one should place this case in the precentral group, since the first symptom was motor weakness. And yet it was evident, when the tumor was exposed at operation, that the point of origin on the falx was well within the boundaries of the frontal lobe. Hence, we have included this case in the group of tumors of the frontal lobe, even though there were symptoms indicating disturbance of the temporal and the precentral lobe.

The question as to whether we are dealing with a neoplasm or with syphilis arises more in the case of lesions of the frontal lobe than of those of other lobes. In three of our cases serologic tests were positive.

one with 20 cells and a colloidal gold curve of 5544432110 in the spinal fluid. But in all three cases there were signs of increased intracranial pressure with papilledema of 2, 3.5 and 5 diopters. We realized, of course, that papilledema was not inconsistent with a diagnosis of syphilis, but the other signs of tumor were sufficiently outstanding to outweigh the positive serologic reactions. As a fact, it has been our practice to attach little importance to positive Wassermann reactions, either of the blood or of the spinal fluid, in persons thought to have tumors of the brain, except when the signs of tumor are vague. When there is undisputable evidence of a mass lesion, even though serologic tests are positive, an exploratory operation is indicated. In attaching little importance to positive serologic reports, we have been influenced in part by our experience of thirty odd years in the neurosurgical clinic of the University Hospital, during which time only one gumma has been exposed on the operating table.

Cranial hyperostosis of a given description is absolutely pathognomonic of fibroblastoma. In the entire series there were altogether ten hyperostoses, and five of them were associated with the frontal lobe group. We have commented already on the significance of the hyperostoses and will comment again in the section on pathology.

In our discussion of the symptom complex of tumors of the frontal lobe we have emphasized a lack of what might be regarded as a specific picture. Our experience harmonizes with that of others in that we have found no sign or symptom exclusively indicative of a tumor of the frontal lobe. To establish a diagnosis involves the proper evaluation of the clinical findings and a critical analysis of all the information obtained from the history, examination and laboratory studies. We attempted to analyze the history and findings in our series and in doing so found four fairly well differentiated subdivisions:

1. In the largest group of cases, numbering eight in all, there were increased pressure, evidenced by headache and by blurred vision, mental symptoms, characterized usually by a quantitative mental deficit and sometimes by a lack of inhibitory power, and, finally, what are much more important, signs or subjective complaints of weakness in the arm or leg of one side. It was this latter symptom that was by far the most useful in indicating a frontoprecentral lesion. This motor phenomenon involving the face, the arm and face, the arm or the arm and leg was not accompanied in a single instance by distortion of the visual fields, a factor of importance in localization.

2. In a second group, there were the mental symptoms already described, generalized convulsions and aphasia. Five cases presented this triad of symptoms. As in group 1 the motor weakness was the predominant sign, in group 2 motor aphasia was of greatest assistance in

localization. It was always predominantly motor, in some instances having been recognized before the patient's admission, and in others elicited only on examination.

3. In a third group, the diagnosis as well as the localization was much simplified by the presence of a cranial hyperostosis.

4. In the fourth, a small group, the only evidence of tumor was that of increased intracranial pressure plus a few vague signs which gave a clue as to its location. In the following case, there was nothing in the history at all suggestive. The presence of a slight faciobrachial monoplegia was the only guide to our conclusions.

CASE 5.—*Failing vision for less than a year; left facial weakness, central in origin; weakness of the left arm; bitemporal hemianopia; a hyperostosis overlying the tumor; almost total blindness; papilledema of 5 diopters on admission, which increased rapidly to 10 diopters. The tumor was removed; convalescence was uneventful; five years later, the patient could read the print of a newspaper.*

Clinical History.—M. L., a man, aged 42, was referred to the neurosurgical service of the University Hospital on June 23, 1925, the chief complaint being failing vision. In July, 1924, the patient had first noted blurring of vision. This had progressively increased until ten weeks prior to admission he could not read; he could distinguish only light. He had never complained of headache, vomiting or loss of the sense of smell. The lenses of his glasses had been changed four times in the past year.

Examination.—The neurologic status was as follows: The patient could perceive only movements of the hands; vision in both eyes was 20/200; a papilledema of plus 5 diopters, on admission, increased rapidly to plus 10 diopters; small hemorrhages were scattered throughout the retina. The fields showed bitemporal hemianopia.

There were no sensory disturbances.

There was definite left facial paralysis of central origin, with slight weakness of the left arm.

There were no pathologic reflexes; slight exaggeration of the right patellar jerk were present.

The pituitary fossa measured 10 by 10 mm.; a roentgenogram showed suggestive hyperostosis in the left frontal region.

Operation and Course.—A right frontal exploratory craniotomy was performed on July 1, 1925, by Dr. F. C. Grant, under local anesthesia. There was considerable oozing from the bone, especially at the hair line, where the bone was very thick, and on reflection of the bone flap we observed hemorrhage from the surface of the dura beneath the area of thickened bone. On reflection of the dural flap, an encapsulated tumor was exposed, which later was found to have its origin in the falx. There was no bleeding from the tumor bed, and the hemorrhage from its point of attachment to the falx was controlled with muscle grafts. The wound was closed without drainage (fig. 10).

The pathologic diagnosis was fibroblastoma.

The immediate result was recovery. When the patient was last heard from, on May 7, 1930, five years after the operation, he was symptom-free. With glasses he could readily read the newspaper.

PRECENTRAL FIBROBLASTOMA

Taken as a whole, fibroblastomas of the precentral region are more readily recognized than those altogether frontal. In each of the eighteen cases of this group there were either convulsions or weakness. In every one of these eighteen cases there was some evidence of either subjective or objective weakness. We regarded this as a symptom of great diagnostic significance, especially when associated with jacksonian convulsions.

In the majority of cases (thirteen of eighteen), there were both a subjective sense and a demonstrable evidence of weakness. During the

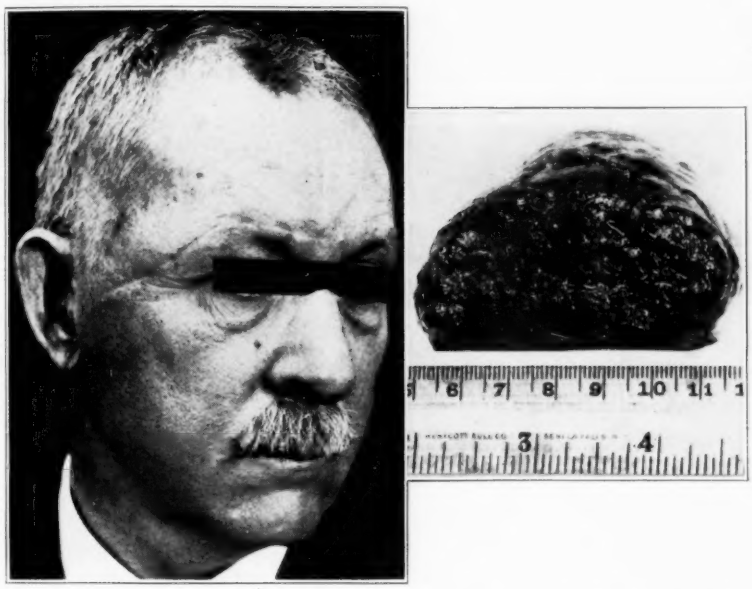

Fig. 10 (case 5).—The photograph of the patient on the left shows the well healed incision. On the right is a fibroblastoma of the frontal lobe, encapsulated, with a relatively smooth surface.

development of the disease the patient was conscious of a sense of weakness in some member, an impression which was confirmed by examination. Three times a weakness was demonstrable without recognition of motor trouble by the patient, though in all these instances the loss of power was unquestionable and must surely have attracted the patient's attention at some time during the course of his illness. In one case only, when a subjective sense of weakness directed our attention to the motor system, could no weakness be demonstrated on examination. However, the occurrence of jacksonian seizures involving only the side of subjective weakness helped to establish the diagnosis. This observa-

tion concerned a man, aged 46, who for eighteen months had had generalized convulsions with attacks of unconsciousness, and more recently jacksonian attacks, confined to the left side. For some time he had had a sensation of weakness of the left side, and had noticed that his mind was sluggish and that he was unable to carry on a sustained conversation. An examination by Dr. Charles K. Mills gave entirely negative results, except for the observation that the patient was somewhat docile and child-like. There was no papilledema. The jacksonian attacks, of themselves, would not of necessity imply a lesion of the precentral area, but their presence plus the patient's complaint of weakness and the mental symptoms prompted us to expose the frontal and precentral areas, with disclosure of the tumor, which was mostly precentral but also frontal. That one may observe motor weakness without convulsions in tumors of the precentral zone is illustrated by case 6.

CASE 6.—*Sudden transitory hemiparesis twelve months previously. Later, the attacks recurred daily, with hemiparesis and loss of eyesight. The tumor was removed; recovery of power in arm and leg, but vision was not restored.*

Clinical History.—L. G., a man, aged 38, was admitted to the neurosurgical service of the University Hospital on May 21, 1930, complaining of weakness in the right arm and leg, pain in the left side of the head and loss of vision. One year before (May, 1929) the face, the right arm and the right leg suddenly became weak and remained so for ten minutes. The arm and face seemed more affected than the leg. His physician attributed the attack to high blood pressure. Eight months ago (October, 1929) he had another attack. Since January, 1930, the attacks had occurred daily; he had had severe pain in the left parietal region, and vision had failed so rapidly that for the past three weeks he had been almost completely blind.

Examination.—Cranial nerves: the optic nerves showed subsiding choked disks and postpapillitic atrophy.

The sensory phenomena were normal.

There was right hemiparesis, involving the face, arm and leg. The patient could walk with difficulty, only with the aid of a cane. The dynamometer measured 40 on both sides. The patient was right-handed.

The right biceps, patellar and achilles tendon reflexes were plus 3.

There was only light perception. The fundi showed slight engorgement of the veins, and many flame-shaped and punctate hemorrhages. The color of the disks was gray; vascularity was poor; there was papilledema of plus 2 diopters on both sides.

The roentgenogram showed no abnormality.

The Wassermann reaction of the cerebrospinal fluid was negative. The pressure was 170 mm.; the protein, 7 units; the color, yellowish.

The preoperative diagnosis was tumor of the left motor cortex.

Operation and Course.—On May 29, 1930, a left frontotemporal craniotomy was performed by Dr. F. C. Grant, with the patient under ether anesthesia by the colonic method. A large flap was reflected from the left temporofrontal region. Oozing from the dural surface suggested the site of the tumor. There was a hyperostosis of the bone flap over the tumor, which had not been observed in the roentgenogram. When the dura was incised, the tumor was seen. The tumor was then

isolated from its bed and, together with the attached dura, removed. The scalp was stripped back sufficiently to remove the hyperostosis. The dural defect was repaired by a flap split from the dura below to the tumor bed. Wound closure was effected with rubber tissue drainage through a stab wound. A transfusion was made with 500 cc. of citrated blood (fig. 11).

The pathologic diagnosis was arachnoidal fibroblastoma.

Uneventful recovery took place from the operation, and the patient was discharged on June 17, 1930. When last seen he was still blind, but was free from other symptoms.

The significance of convulsions in precentral fibroblastoma should be given minute consideration. There was a history of convulsions in ten cases, eight jacksonian and two general. In the latter, the convulsions were associated with other symptoms of diagnostic value, such as

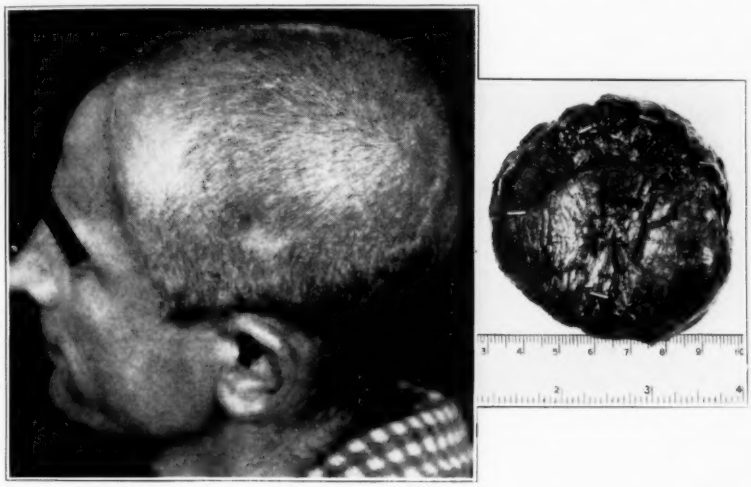

Fig. 11.—On the left is a lateral view of the patient, showing the well healed scar of the left frontoparietal craniotomy. On the right, the well encapsulated tumor is seen with the finely lobulated surface and the dural attachment. Large vessels flow across the surface.

hyperostosis, or hemiplegia with motor aphasia. In seven of the eight cases in which jacksonian attacks occurred there was an accompanying weakness of the face, arm or leg, which led us to a presumption but was by no means a certificate of their precentral localization. However, it may be said that given jacksonian convulsions with an accompanying monoplegia or hemiplegia in a case with increased intracranial pressure, in the absence of cuts of the visual field, the tumor in all probability involves the precentral gyrus. This statement is supported by the evidence in our cases of precentral fibroblastomas.

To repeat, however, jacksonian convulsions do not always imply a precentral lesion. A survey of our seventy-five cases of cerebral fibro-

blastomas soon shows that jacksonian convulsions may be evoked by lesions in almost any part of the brain, actually in the frontal, precentral, temporal and parietal regions. It is not so surprising that generalized convulsions were excited by tumors widely distributed; as a fact, in our series they occurred with tumors in every lobe except the parietal.

In case 7 the history was of interest because of the long duration of the illness. Despite the persistence of the convulsive movements of the right arm for all of six years, the patient, up to the date of admission to the hospital, had been treated for syphilis in every conceivable way.

CASE 7.—*Convulsive seizures of the right arm for six years, increasing in frequency and severity and being exceedingly painful. It was chiefly because of pain that the patient sought relief. A fibroblastoma involving the precentral gyrus was successfully removed. The tumor measured 7 by 4.5 by 3.5 cm.*

Clinical History.—J. G. H., a man, aged 60, was admitted to the neurosurgical service of the University Hospital on Feb. 4, 1922. Six years before (July, 1916) he had had a sudden violent pain in the right arm, with twitching of the right side

TABLE 5.—*Incidence of Convulsions in Fibroblastomas*

Location	Jacksonian Convulsions	General Type
Frontal	3	4
Precentral	8	2
Temporal	2	3
Parietal	5	0
Occipital	1	4

of the face and right arm. He did not lose consciousness, but for the next two days there was a definite speech defect. He was paralyzed on the right side for several days, but recovered completely and continued well for two years, when he had a second attack, again with severe pain and twitching of the right arm. The face and leg were not involved, and there was no speech defect. Since the second attack, a hemiparesis had developed gradually.

For the past four years the painful convulsions had continued, at first at intervals of two months, then more and more frequently. A convulsion always began in the right arm, involved the leg but not the face, was accompanied by great pain (probably due to muscular spasm) and lasted from two to four minutes, but was not attended with loss of consciousness. In January, 1922, the patient had twenty-five convulsions in twenty-four hours.

During the four year period he had suffered from headaches, at first on the left, but later involving the whole head. They were not attended with vomiting, and the eyesight seemed unimpaired.

Examination.—None of the cranial nerves was involved.

The patient complained of burning pain on the surface of the thigh. There was no impairment of objective sensation. He was unable to recognize objects in the right hand (astereognosis).

The right arm was totally paralyzed and hung limply at the side. The patient complained of pain whenever the arm was moved or put in an unnatural position.

The right biceps, triceps and patellar tendon reflexes were increased; there were no pathologic reflexes.

The patient understood perfectly all that was said to him, but his speech was indistinct.

Ocular rotations were full, and the pupils reacted to light and in accommodation. The disks were a dirty gray; the margins were hazy, but there was no choking.

Operation and Course.—Left parietal craniotomy was performed on Feb. 10, 1922. A flap was reflected to uncover the brain on either side of the rolandic fissure. It became evident that there was hyperostosis overlying the tumor. The

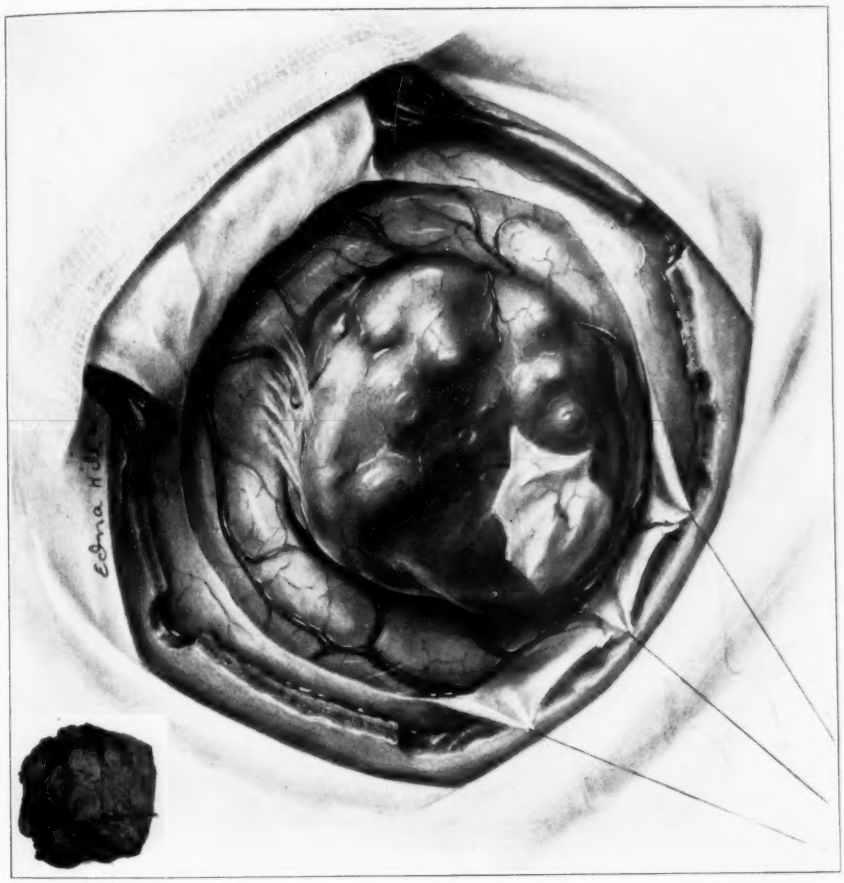

Fig. 12 (case 7).—A view of the tumor exposed at operation, showing the dural attachment, the well encapsulated appearance and the extracerebral location. The insert shows the tumor after removal.

dura overlying the tumor was infiltrated, and that portion attached to the tumor was removed with the tumor. The tumor was encapsulated, measured 7 by 4.5 by 3.5 cm. and was in contact with but not adherent to the falx. The superior margins of the cranial opening had to be rongeured away in order to secure adequate exposure of the tumor area. The dural defect was repaired with a fascial graft (fig. 12).

The pathologic diagnosis was fibroblastoma.

The patient was discharged from the hospital on March 4, 1922. He recovered some, but never complete, power in either the arm or the leg. On Dec. 23, 1926, four years after the operation, he succumbed to pneumonia. There were no signs of recurrence.

Comment.—Case 7 is of interest from many angles. We have already discussed the differential diagnosis between syphilis and tumor. Of course, the persistence of the antisyphilitic treatment for a period of six years, no matter what the serologic findings, is a relic of the practice of a generation ago, when a cerebral lesion was regarded as syphilitic unless other causes were proved. Especially worthy of comment was the painful character of the convulsions, which is not easy to explain. That the convulsions should persist as "focal" in character for so many years without eventually becoming general, and that at no time was there loss of consciousness, should be noted in passing.

It is well to remember that the weakness that follows the convulsion either at the beginning or throughout the entire period of the illness may be only transitory. In one case the patient had had but one attack of unconsciousness, and this was followed by a brief period of weakness in one leg. At no other time had he lost consciousness, and at no other time was there weakness in either extremity up to the time of the operation. Likewise, in another instance, the patient had had several convulsions and after each only transitory weakness in the arm and face. In each of these cases a large fibroblastoma was found and removed. These illustrations are cited merely to emphasize the diagnostic significance of transitory weakness following a convulsion.

Motor jacksonian convulsions occurred, therefore, in our cases of cerebral fibroblastoma situated anywhere over the convexities. They were most frequent in tumors lying in the precentral areas, and were usually accompanied by weakness without cuts in the visual field.

In practically every one of the fibroblastomas of the temporal and the parietal lobes that caused jacksonian convulsions there was accompanying weakness of the affected side. In cases of tumors of the temporal lobe, in addition, there may be an accompanying homonymous hemianopia, aphasia, and in the tumors of the parietal lobe, astereognosis or some sensory disturbance of a cortical nature, as in case 8.

CASE 8.—*Twitching of the right side of the face and shoulder for three years, accompanied by loss of consciousness; later, awkwardness in movements of the right arm and leg, paresthesias in the hand and arm, astereognosis, motor aphasia, headache and failing vision with choked disks. An encapsulated tumor was removed from the prerolandic region, and the patient made an uneventful recovery.*

Clinical History.—W. J., a man, aged 42, was referred to the neurosurgical service of the University Hospital on Jan. 9, 1922, by Dr. A. M. Ornsteen, complaining chiefly of inability to use the right hand. Three years before (1919) he had noticed twitching of the right side of the face. This was followed a month

later by a similar attack, which spread to the shoulder. During these attacks he lost consciousness. One month after the onset of the attacks he found that his right hand was clumsy, and that he could not handle small objects with it and was unable to recognize them in his hand.

For two years he had noticed drooping of the right side of the face and for the past four months that the right leg was weak and that he dragged it. He had difficulty in expressing himself; he seemed to know what he wished to say, but could not find the proper words. In addition, he had difficulty in expressing his thoughts in writing. The characters were formed slowly and laboriously, and sometimes "the pen does not seem to behave." Letters were left out or malformed.

At the time of examination the patient complained of headache, occipital in distribution, which was not constant, was worse at night, lasted for from ten to fifteen minutes and was extremely intense. The senses of smell and taste were not as acute as formerly. There was a rumbling in both ears, a sound which he compared to locomotives at a distance. The eyesight was impaired; he could not read for any length of time, and the characters were blurred. He understood what he read and could read aloud. Occasionally he had paresthesias in the hand and arm. His inability to perceive objects with the right hand annoyed him, especially because of his fondness for driving an automobile and his handicap in managing the steering wheel.

Examination.—The left pupil was slightly larger than the right.

The tactile and pain sensations and the sense of position were maintained throughout. The patient could not recognize the form of objects with his right hand (astereognosis).

The biceps and triceps tendon reflexes were normal and equal on the two sides; the patellar and achilles tendon reflexes were slightly above normal, but equal. There was definite weakness in the lower facial distribution on the right side. The patient could close the eye and wrinkle the forehead well, but could not elevate the right angle of the mouth. Neither the right arm nor leg was spastic or weak, but he was clumsy in the use of the right arm. In grasping objects he used the whole hand in order not to drop them. Similarly, he was awkward and clumsy in the use of the right leg.

Both pupils reacted to light and in accommodation; there was no nystagmus; ocular rotations were full; the margins of the disks were blurred; the veins were full and tortuous; there were no hemorrhages or exudates. There was papilledema of plus 4 diopters on the right, and of plus 3 diopters on the left.

The roentgenogram showed no abnormality.

Operation and Course.—A left parietal craniotomy was performed on Jan. 16, 1922. The flap was fashioned to uncover the left prerolandic region. The dura was under great tension and extremely vascular. Tension was relieved by ventricular puncture and an intravenous injection of sodium chloride. On reflection of the dural flap, the tumor was discovered, sharply defined. That portion of the dura to which the tumor was attached was removed with the tumor. The defect in the dura, 6.5 by 8.5 cm., was repaired with a fascial graft. The wound was closed with rubber tissue drainage. Five hundred cubic centimeters of citrated blood was given intravenously at the conclusion of the operation.

The pathologic diagnosis was fibroblastoma.

The patient recovered from the operation and was discharged from the hospital on Feb. 11, 1922. In the early convalescent period the papilledema receded, and the awkwardness in the movements of the right arm and leg disappeared. When last heard from the patient was symptom-free.

The predominance of motor phenomena in the precentral tumors, represented by motor weakness and convulsions, is apparent. There were but few other associated signs or symptoms, and these were either evidences of increased intracranial pressure or were due to encroachment of the tumor on contiguous zones.

TABLE 6.—*Symptoms in Eighteen Cases of Precentral Fibroblastoma*

1. Signs of Increased Intracranial Pressure	
Headache	3
Choked disks	3
Vomiting	1
Failing vision	3
General convulsions	2
2. Roentgenographic Evidence	
Hyperostosis	3
Calcification of inner table	1
Calcification of tumor	1
Displaced pineal gland	1
3. Focal Symptoms	
Hemiplegia	5
Hemiparesis	8
Jacksonian seizures	8
Hemianopia	1
4. Neighborhood Symptoms	
Exaggeration of reflexes	9
Impaired sense of position	3
Astereognosis	2
Aphasia	1
Agraphia	1
Dyssynergia	1
Incoordination	2
Mental impairment	1
Facial weakness	2
Uncinate attacks	6

TEMPORAL FIBROBLASTOMAS

The localizing evidence of fibroblastomas in the temporal region is not as salient as that in either the frontal or the parietal lobes. Hence their localization is often a problem, and the symptoms and signs are often difficult of interpretation. The symptoms will vary, depending on which portion of the temporal lobe is compressed. As in tumors of the frontal lobe there is no great uniformity of symptoms and signs, the diagnosis and localization may require much patience and study.

Tumors of the right temporal lobe obviously are more difficult of recognition than those of the left, and this is especially true when there is no field defect. Ten of our eighteen fibroblastomas of the temporal lobe were on the right side. In two the location of the tumor was indicated by a calcified shadow on the roentgenogram. In both cases there were other localizing signs, but the calcified shadow of itself was all-sufficient. In a third case, which was clinically obscure, a large cranial hyperostosis in the right frontotemporal region was of great help. Tinnitus and impairment of vision had developed, and the patient had had deafness in the right ear for four months, and in the left ear for one month before admission. Examination revealed only a left third and left sixth nerve palsy. Although there were no symptoms that were specifically of temporal lobe origin, the cranial nerve palsies plus the hyperostosis at once established the location of the tumor.

In still another case, the hyperostosis at the base of the skull in the temporal fossa was an invaluable guide. This patient, a woman, aged 40, had suffered pain in the right temple for eleven months and frontal

headaches for almost the same period. Almost simultaneously she experienced terrific pain in the right side of the face; the pain was of an intermittent nature, followed by numbness, and occurred in attacks which lasted from five to fifteen minutes. She had noticed failing vision for four months. The fundi showed 6 diopters of choking. The spinal fluid pressure was 490 mm. of water. The only objective findings were a diminished corneal reflex on the right and a slightly hyperactive patellar reflex on the left. These were hardly sufficient to determine an exact localization, and yet there were reasonable grounds for believing that the patient had a tumor. The type of pain was not that of a tumor of the gasserian ganglion. The revelation by the roentgenogram of markedly thickened bone in the right middle fossa, below and behind the lesser wing of the sphenoid, supplied conclusive evidence.

As with tumors other than fibroblastomas in the right temporal lobe, there may not be an inkling or clue as to the location of the tumor. This was particularly true in the case of a young woman, aged 34, who presented all the signs of increased intracranial pressure but nothing else. Had Dr. Pancoast not discovered a hyperostosis in the right temporal region we would have been altogether at sea as to what region to explore. Guided by the site of the hyperostosis, the right temporal region was explored, and an encapsulated tumor was removed; it proved to be a fibroblastoma. This observation was made in 1918, before the practice of ventriculography was introduced.

In two of our cases of tumor of the right temporal lobe a left homonymous hemianopia helped in the localization; in one case there was evidence of encroachment on the parietal lobe, and in the other, as in case 9, there were only a left homonymous hemianopia and hyperactive reflexes on the left side.

CASE 9.—*Increasing occipital headaches, accompanied by projectile vomiting, for seven months. Examination revealed only a left homonymous hemianopia. In a two stage operation a large fibroblastoma was removed from the right temporal lobe.*

Clinical History.—V. T., a white woman, aged 43, was referred to the neurosurgical service by Dr. William G. Spiller and Dr. William J. Middleton on Oct. 6, 1930. She had been in good health until April, 1930, when she complained of pain in the left eye and occipital headaches. Iodides were administered, and glasses were fitted, with improvement in vision. However, the headaches became progressively worse and were frequently accompanied by projectile vomiting.

Examination.—Neurologic examination revealed an extreme mental dulness, bordering on stupor.

The papilledema on both sides measured plus 3 diopters. There were retinal hemorrhages and a left lateral homonymous hemianopia.

The deep and superficial sensations were preserved.

There was no loss of power on the contralateral side.

A roentgenogram showed complete atrophy of the dorsum sella.

On Oct. 13, 1930, as the patient was being prepared for ventriculography, the respiratory rate suddenly dropped to 10, the pulse was weak and thready, and the patient became cyanotic. She was immediately placed in the prone position, and the ventricles were tapped; 7 cc. of fluid was removed from the right and 20 cc. from the left ventricle. The patient improved after the evacuation of the ventricles, and the "ventricular estimation" pointed to a tumor of the right hemisphere.

Operation.—The first stage of a craniotomy was performed on Oct. 13, 1930. Under local anesthesia a right temporofrontal bone flap was reflected. The brain was extraordinarily tense. The dura was opened, and the tumor exposed. The dura about the tumor was incised anteriorly, laterally and posteriorly. Because of the critical condition of the patient no attempt was made to remove the neoplasm. The entire bone flap was removed and the wound closed.

Second Admission.—On Feb. 4, 1931, there were marked weakness of the left upper extremity (the dynamometer readings were: right, 35; left, 0), slight weakness of the left lower extremity and a left facial weakness of the central type.

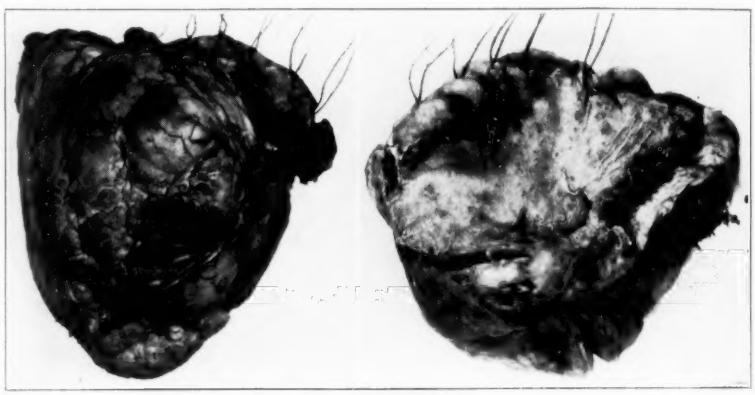

Fig. 13 (case 8).—This large, well defined, encapsulated tumor was removed from the right temporal region. It is firm and quite vascular. The dural attachment is visible.

Vision in both eyes was 6/16; the fields showed moderate concentric contraction. The eyegrounds showed secondary optic atrophy.

Second Operation and Course.—The second stage of the craniotomy was done on Feb. 20, 1931, by Dr. Grant. Under local anesthesia the original flap was reflected, and a large tumor, with the characteristics of a fibroblastoma, together with the overlying adherent dura was removed from the right temporal lobe. A small fringe of tumor tissue adherent to the dura near the longitudinal sinus was coagulated, and 500 cc. of citrated blood was given at the termination of the operation (fig. 13).

Convalescence was unusually rapid and uneventful. The patient was out of bed on the fourth day, and was discharged twelve days after the operation. At the time of discharge the weakness of the face and left upper extremity had greatly improved. On Dec. 9, 1931, the notation was: "This woman is entirely well in every way. No symptoms. Wound is perfect."

In one remarkable fibroblastoma of the right temporal lobe there was an extension into the posterior fossa. The patient had noticed weakness and pain in the angle of the jaw for one year and blindness in the right eye for two months. This was followed a few weeks later by blindness in the left eye, and more recently by headaches. Examination revealed a rather widespread involvement of the cranial nerves. There were stiff pupils, loss of sensation over the entire right trigeminal area, weakness of the palate on the right, absence of the right corneal reflex, ataxic gait and station and absent patellar and achilles tendon reflexes. A subtemporal decompression was performed, and necropsy later revealed a large tumor of the right temporal lobe, extending into the posterior fossa.

It is surprising that of our eighteen cases of fibroblastoma of the temporal lobe, only six were associated with homonymous hemianopia, four in the right, and two in the left, lobe. The reason for this deserves comment. It is presumable that homonymous hemianopia is found only in cases of tumors of the temporal lobe in which the tumors exert deep enough pressure to compress the optic tracts. Tumors lying deep in the sylvian fissure produce this effect; those lying laterally over the surface of the temporal lobe are probably less apt to cause a distortion of the visual field. Especially in the right lobe, the finding of homonymous hemianopia at once determines the laterality. If there is any doubt as to whether one is dealing with a tumor of the occipital or the temporal lobe, the distinction to which Horrax [1] called attention should be helpful. Horrax found, and our records support his findings, that whereas in tumors of both the temporal and the occipital lobes there may be a homonymous cut in the fields, in the case of the latter central vision is usually preserved, while in the former it is usually lost. In our six cases the hemianopic defect was cleancut. Three showed a definite cut in central vision, one of them down through the middle of the central field; two showed only a slight central field cut; one showed none at all.

Altogether, of the eighteen tumors of the temporal lobe, eight were associated with hemiparesis or hemiplegia. Of the eight cases, four showed homonymous hemianopia; two were combined with aphasia, one purely motor, the other both motor and auditory. Given a homonymous hemianopia with weakness or with weakness and aphasia of a motor or auditory type, the localization cannot be questioned.

Of the remaining three cases of tumor of the left temporal lobe, one was localized by means of a ventriculogram. The symptoms in this case included headache, dimness of vision, failing memory, diplopia and a

1. Horrax, G., and Putnam, T. J.: Distortions of the Visual Fields in Cases of Tumor of the Brain: VII. Field Defects and Hallucinations Produced by Tumors of the Occipital Lobe, Tr. Am. Neurol. A., 1932, p. 115.

subjective weakness. In the other two cases there were signs of increased intracranial pressure but no localizing symptoms with the exception of a left facial weakness of central origin in one case.

With the exception of aphasia and the homonymous field defects there were in our series only occasional signs suggestive of lesions of the temporal lobe. Moreover, other signs characteristic of lesions of the temporal lobe, such as uncinate attacks, visual hallucinations and dreamy states, were conspicuous by their absence. Other symtoms, neighborhood and miscellaneous, are included in table 7.

PARIETAL FIBROBLASTOMAS

Of the seventy-five cases of this series, the smallest number, eight, were found in the parietal lobe. The parietal fibroblastomas were

TABLE 7.—*Symptoms in Eighteen Cases of Fibroblastoma of the Temporal Lobe*

1. Signs of Increased Intracranial Pressure		4. Neighborhood and Misc. Symptoms	
Choked disks	8	Mental impairment	2
Headache	9	Loss of memory	2
Vomiting	1	Exaggerated reflexes	6
Failing vision	10	Subnormal reflexes	2
General convulsions	2	Focal convulsions	3
		Hemiparesis	6
		Hemiplegia	2
		Facial weakness	1
		Tremors	2
2. Roentgenographic Evidence		Hemianesthesia	2
Hyperostosis	3	Impaired sense of position	1
Calcification	2	Astereognosis	1
Atrophy of dorsum sellae	3	Ataxia	2
Atrophy of posterior clinoid processes	2	Dysmetria	1
		Dyssynergia	2
		Nystagmus	1
		Anosmia	2
		Tinnitus	1
		Vertigo	1
3. Focal Symptoms		Cranial nerves: Oculomotor	1
Hemianopia	6	Trigeminus	3
Aphasia	2	Abducens	3
Taste impaired	3	Facialis	1
		Corneal anesthesia	2

accompanied either by a very high or a relatively low intracranial pressure, or by no increase in pressure. In two instances the papilledema varied between 5 and 7 diopters, in one from 1 to 2 diopters, and in four cases there was no papilledema whatever. Loss of stereognostic sense, when present, was a sign of great importance. It was present in three of our cases, once on the left side and twice on the right. In one instance it was perhaps the only sign that indicated involvement of the parietal lobe.

This patient had had an illness of short duration, suffering from fainting attacks and headaches for three weeks before admission to the hospital, and from nausea and vomiting for one week. The symptoms included a low degree of papilledema (from 1 to 2 diopters), weakness of the left hand, face and tongue of a central type, a hyperactive patellar reflex on the left, a left ankle clonus and a stereognostic sense much

impaired in the left hand. Later, a tumor was found in the right parietal lobe and removed.

The following parietal fibroblastoma was remarkable because of its enormous size and of the paucity of symptoms. The patient, aged 10, had had a lump on her crown at 6 years of age, a lump which had grown in all directions and at the time of admission was the size of a grapefruit (fig. 14). For one year she had had right frontal headaches and twitchings of the right leg from the knee to the ankle. Examination revealed unsteady station, incoordination of the right side, dysmetria of the right hand and hyperactive reflexes on the right side. There

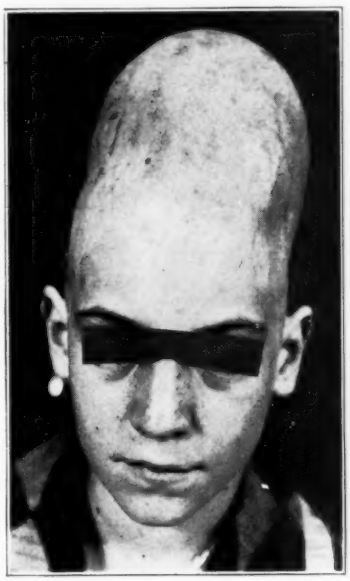

Fig. 14.—Front view of the patient, showing the enormous hyperostosis produced by a fibroblastoma of the parietal lobe of the flat type, straddling the midline and compressing both parietal lobes.

were no signs of increased pressure either in the eyes or on manometric test. A roentgenogram showed a hyperostosis involving the entire vault from the coronal to the lambdoidal suture. Beneath it lay a large, soft tumor involving the dura, superior longitudinal sinus and both parietal lobes. The extracranial growth was tremendous, but the symptoms and signs of an intracranial tumor were surprisingly few.

Another illustration of the few clinical signs elicited by tumors of the parietal lobe is shown in case 10. Had not this patient had a hyperostosis in the left parietal bone, a diagnosis would probably have been impossible, except by the injection of air. The symptoms were

confusing, and consisted of mental symptoms, headache and, on one occasion, a generalized convulsion, none of which, certainly, pointed to a tumor of the parietal lobe.

CASE 10.—*Six years and two years before admission, a "nervous breakdown," and ten months before admission, a convulsion with loss of consciousness. On admission, slowness of speech, stupor and intense headache. Hyperostosis in the right parietal region. An encapsulated tumor and the hyperostosis were removed. The patient recovered and resumed his profession.*

Clinical History.—G. J. McC., a man, aged 43, was referred to the neurosurgical service of the University Hospital on April 7, 1928, by Dr. William G. Spiller, complaining chiefly of headaches. Six years before admission (1922) he suffered from a nervous breakdown, which he described as a "dazed mental condition and complete exhaustion." He had also had an attack of shingles. After a rest period of six months he was perfectly well, but two years later (1924) he again lost his usual vitality and became easily fatigued. Two years before admission (1926) he was thrown from an automobile, striking against the left side of his head. He was dazed but was not rendered unconscious.

About ten months before admission, while taking part in a baseball game on a hot day, he suddenly began to swing his bat wildly. He felt queer, was dazed and was completely disoriented for two or three hours. Following this episode he lost consciousness and had a convulsion. At this time he complained bitterly of headache. Since this attack, however, he had had periods of confusion, during which it became impossible for him to continue his duties as a minister. Three weeks prior to admission, he complained of great weakness, and for two weeks of headache, especially in the occipital region; these were accompanied by a sensation of tightness, in which he felt his head being pulled back. For two weeks he had been vomiting.

Examination.—The neurologic status was as follows: The patient was bedridden and semistuporous; speech was slow, and the mental processes were retarded. Near the posterior margin of the left parietal bone was a swelling or elevation about the size of a half dollar, 1 cm. above the level of the surrounding contour of the skull. There were no motor or sensory disturbances, field distortions or papilledema. The tendon reflexes were hyperactive.

A roentgenogram revealed the appearance of a hyperostosis in the left parietal region of the skull.

The preoperative diagnosis was fibroblastoma, left parietal.

Operation and Course.—A left parieto-occipital craniotomy was performed on April 9, 1928, under local anesthesia. A flap of the scalp, wide of the bony protuberance, was reflected, and the hyperostosis together with the surrounding bone 1 inch (2.5 cm.) from the margin of the hyperostosis was resected. On removal of the bone the tumor extruded itself, so that it bulged from 4 to 5 cm. above the level of the surrounding dura, so great was the tension. A portion of the tumor was scalloped out first with the electric knife, and the remainder was readily isolated and removed. Hemostasis and closure of the wound were carried out without drainage (fig. 15).

The pathologic diagnosis was fibroblastoma.

The patient was discharged from the hospital on May 27, 1928. Headache had entirely disappeared, and he has been able to resume professional work and to carry on since then.

In only one of our parietal fibroblastomas was an injection of air necessary. In this case there were convulsive attacks involving the left arm and leg, with loss of consciousness. These had recurred at infrequent intervals for two years. There was no papilledema or increase in the spinal fluid pressure. Examination revealed only a slight

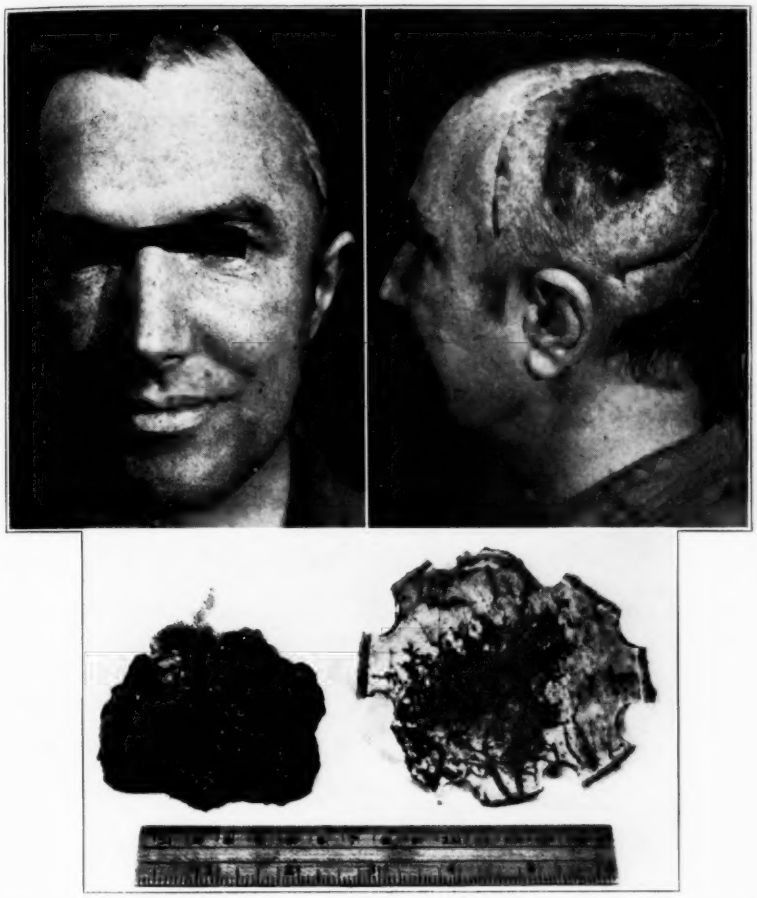

Fig. 15.—The upper picture on the left is an anterior view of the patient, demonstrating the slight depression in the left parietal area following the removal of the tumor and diseased bone. The upper picture on the right shows the well healed temporoparietal craniotomy wound through which a large tumor was removed. The picture on the bottom shows the under surface of the bone, demonstrating the markedly dilated vascular channels, the infiltration of the inner table by the tumor and the relative lack of thickening of the skull.

dysmetria of the left hand. Despite the absence of pressure, the occurrence of jacksonian convulsions in a patient aged 45 was suggestive of

tumor, and an injection of air revealed a tumor of the right parietal area. Later, this was exposed and removed.

In some instances the extent of the tumor as revealed by the symptoms and signs is confusing because of the expansion of the tumor beyond its point of origin. This is illustrated in case 11, in which the tumor sprang originally from the sylvian fissure and spread into the parietal area, giving symptoms of involvement of the parietal lobe. Had only the parietal lobe been exposed, as was indicated by the symptomatology, the entire extent of the tumor would not have been revealed.

CASE 11.—*No localizing signs other than sensory jacksonian attacks in the right leg, with evidence of increased pressure indicated by 7 diopters of choking in each eye and 624 mm. of water pressure in the spinal fluid. Discovery of the tumor, lying subcortically, on attempted ventricular puncture.*

Clinical History.—R. R., a man, aged 24, was admitted to the neurosurgical service of the University Hospital on Jan. 10, 1928, having been referred by Dr. Burton Chance; he complained of attacks of numbness in the right leg, which had recurred at intervals over a period of two and one-half years. The numbness began in the leg, spread up to the arm, face and tongue and was associated with dysarthria. Recently, only the leg had been involved. There had been no paralysis with the attacks. Two and one-half months before admission, the patient noticed difficulty in reading, and at the time of admission he could read only large print. Recently there had been attacks of blindness lasting from one to two minutes.

Examination.—The neurologic status was normal.

There was papilledema of 7 diopters in each eye.

The pressure of the cerebrospinal fluid measured 624 mm. of water.

A roentgenogram was normal.

On attempted ventricular puncture, the cannula came in contact with an obstruction, which was interpreted as a tumor; ventriculography was abandoned.

Operation and Course.—A left temporoparietal exploratory craniotomy was performed on Jan. 19, 1928. The tumor was parallel with and a little below the sylvian fissure on the left; it was reached by a transcortical incision.

The pathologic diagnosis was fibroblastoma.

The patient made an uneventful recovery, and when last seen on March 16, 1932, he was practically symptom-free.

It has not been an easy task to assign each tumor to its proper group. In some instances our decisions of necessity have been arbitrary. In many instances the tumor extended beyond the limitations of a given lobe and the clinical picture has been correspondingly complex. This was the case in the majority of our series. In some instances the initial symptom might not be due to disturbance of function of the lobe in which the tumor originated. For example, a patient with a tumor that originated far forward in the frontal lobe might have, as the initial symptom, motor weakness of precentral origin. In table 8 we have tabulated all the symptoms observed in the parietal lobe series.

OCCIPITAL FIBROBLASTOMAS

In this group we present nine cases, and for convenience of study the symptoms are presented in table 9. In the localization of tumors of the occipital lobe one must be guided almost altogether by the presence or absence of field defects. In our series there were four cases of homonymous hemianopia. In two other cases the localization was established by a roentgenogram, which revealed in one a hyperostosis and in the other an area of calcification.

It is not always possible to differentiate a hemianopia due to a lesion of the temporal lobe from one due to a tumor of the occipital lobe. The

TABLE 8.—*Symptoms in Eight Cases of Fibroblastoma of the Parietal Lobe*

1. Signs of Increased Intracranial Pressure		4. Neighborhood and Misc. Symptoms	
Choked disks	3	Mental impairment	2
Headaches	2	Change of personality	1
Vomiting	2	Focal convulsions	5
Failing vision	1	Exaggerated reflexes	3
General convulsions	0	Hemiparesis	5
		Hemiplegia	2
		Ataxia	2
2. Roentgenographic Evidence		Dysmetria	3
Hyperostosis	1	Dyssynergia	4
Calcification	1	Aphasia	2
Atrophy of dorsum sellae	1	Word blindness	1
Atrophy of posterior clinoid processes	1	Word deafness	1
		Uncinate attacks	1
		Cranial nerves: Abducens	1
		Facialis	2
3. Focal Symptoms		Vagus	1
Impaired sense of position	3	Accessorius	1
Astereognosis	3	Hypoglossus	

TABLE 9.—*Symptoms in Nine Cases of Occipital Fibroblastomas*

1. Signs of Increased Intracranial Pressure		4. Neighborhood Symptoms	
Choked disks	3	Aphasia	4
Headache	3	Ataxia	1
Vomiting	1	Impaired sense of position	2
Failing vision	2	Hemiplegia	3
General convulsions	4	Mental impairment	4
		Hallucinations	1
2. Roentgenographic Evidence		Yawning	1
Calcification	1	Romberg positive	1
Atrophy of dorsum sellae	1	Reflexes exaggerated	2
Hyperostosis	2	Focal convulsions	1
3. Focal Symptoms			
Hemianopia	4		

hemianopias of the temporal lobe are more apt to be quadrantic cuts in the beginning, but occasionally, as in one case of our series, fibroblastoma of the occipital lobe is characterized by such a quadrantic defect. We have observed one fact of value in the study of our tumors of the occipital lobe, namely, that the nature of the field defect is dependent on the position of the tumor. A tumor growing mesially and low down in the occipital region, so that it comes early to compress or invade the striate area, produces a cleancut hemianopia from the onset. On the contrary, one which compresses the occipital lobe on

its lateral aspect is prone to cause a field defect that is more irregular than that from a mesially situated tumor. As we remarked in discussing fibroblastomas of the temporal lobe, the preservation of central vision in homonymous hemianopia is presumptive evidence of a lesion of the occipital lobe as contrasted with one of the temporal lobe. But with all the emphasis we have laid on hemianopia, it is surprising that only four of nine of the tumors in this region gave rise to this distortion of the field.

It is well to remember that in a certain percentage of cases of tumor of the occipital lobe there will be signs of cerebellar dysfunction. Pressure of the tumor on the cerebellar hemisphere through the tentorium readily accounts for the symptoms of cerebellar origin. Such were the physical conditions in case 12.

CASE 12.—*Headaches and dizzy spells for four months, with symptoms of a tumor of the left occipital lobe of large dimensions. Ten years later, signs of recurrence; twelve years after the first operation the recurrent tumor was removed with complete relief of symptoms. Two years after the second operation the patient was symptom-free.*

Clinical History.—M. P., a woman, aged 41, was admitted to the neurosurgical service of the University Hospital on Feb. 6, 1918, complaining chiefly of headache, dizziness and failing vision. She had had headaches for four months; at first they occurred only in the morning, but more recently they had become constant. Simultaneously, dizzy spells occurred, and these usually made their appearance with the headaches. She had had one attack of unconsciousness, which lasted for only a few minutes. Four months before admission she tended to stagger in walking in the dark, and later in daylight. For three months vomiting had been a marked symptom, and for the same length of time vision in the right eye had been failing. She had lost 20 pounds (9 Kg.); recently, memory had been affected.

Examination.—Neurologic examination showed only a slightly hyperactive right patellar reflex.

The vestibular reactions suggested pressure over the cerebellum.

There was papilledema of 5 diopters on the right and of 4 diopters on the left; there was a clearcut right homonymous hemianopia (fig. 16).

A roentgenogram showed the sella turcica slightly enlarged; the posterior clinoid processes were somewhat attenuated.

The pressure of the cerebrospinal fluid was 146 mm.

Operation and Course.—A left occipital craniotomy was performed on Feb. 19, 1918, under ether anesthesia. The dura was under tremendous tension, and an attempt to evacuate the ventricle failed. A large tumor was present on the mesial surface of the occipital lobe; this was enucleated without difficulty, except at its attachment to the falx.

The tumor was encapsulated and lobulated. Grossly, it appeared to be a fibroblastoma. This was confirmed by histologic examination.

The patient made an uneventful recovery. The homonymous hemianopia and other symptoms completely disappeared, and on discharge she was able to resume her former occupation.

Second Admission.—In April, 1930, twelve years after the first operation, the patient was readmitted to the University Hospital. For about ten years after the

operation she had been perfectly well, but two years prior to this admission a dull, constant frontal headache developed, and she noticed failing vision in the right eye. For four or five months she had been staggering, and for the same length of time she had noticed deafness in the left ear, loss of memory and difficulty in pronouncing words.

Examination at this time revealed a right hemianopia, and some dysmetria and dyssynergia, which were more marked in the left arm than in the right arm. Her memory was poor; the patient was dull and unresponsive. The spinal fluid pressure was 260 mm. There was no papilledema.

A roentgenogram revealed displacement of the pineal body to the left.

Second Operation and Course.—On May 3, 1930, the old bone flap was reflected, and the tumor was found presenting on the surface about the middle of the cranial opening and near the midline. The tumor, together with the overlying dura, was removed in toto except for an attachment to the falx, near the longitudinal sinus. What appeared to be a separate and distinct tumor, well encapsulated and about the

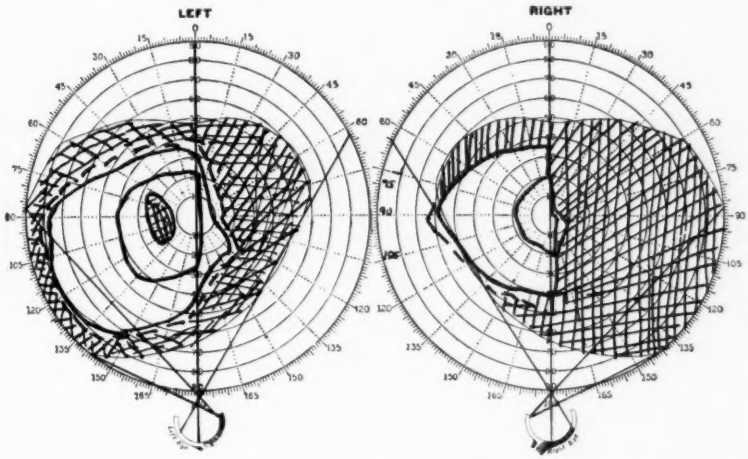

Fig. 16 (case 12).—Visual fields taken on April 12, 1930, showing a right homonymous hemianopia with a tendency to a cut in the central vision on the right side.

size of a peach, in contact with the tentorium but apparently having no attachment either to that or to the falx, was found and removed (fig. 17).

Recovery was uneventful. Again the hemianopia and other symptoms disappeared, and the patient was able to return to work. Two years after the second operation she was symptom-free.

We note in the records of our nine tumors, primarily occipital, three patients with hemiparesis, four with aphasia and two with impaired sense of position. Thus, with tumors of the occipital lobe, as with those elsewhere, neighborhood symptoms are not uncommon. In case 13, it is more than likely that the difficulty of spelling words and deliberate speech were signs of an early mental deficit rather than a deficit of the speech center. Whether or not the temporal lobe was involved, the

loss of sense of position, noted in the examination, unquestionably implicates the parietal lobe, although there was no loss of pain, touch or temperature sense and no astereognosis.

CASE 13.—*General convulsions for three years, with difficulty in concentration, impairment of sense of position, homonymous hemianopia and a calcified shadow; recovery following removal of a tumor of the occipital lobe; no recurrence five years later.*

Clinical History.—W. G. R., a man, aged 57, was referred to the neurologic service by Dr. William G. Spiller and Dr. M. V. Ball, of Ridgway, Pa., on Feb.

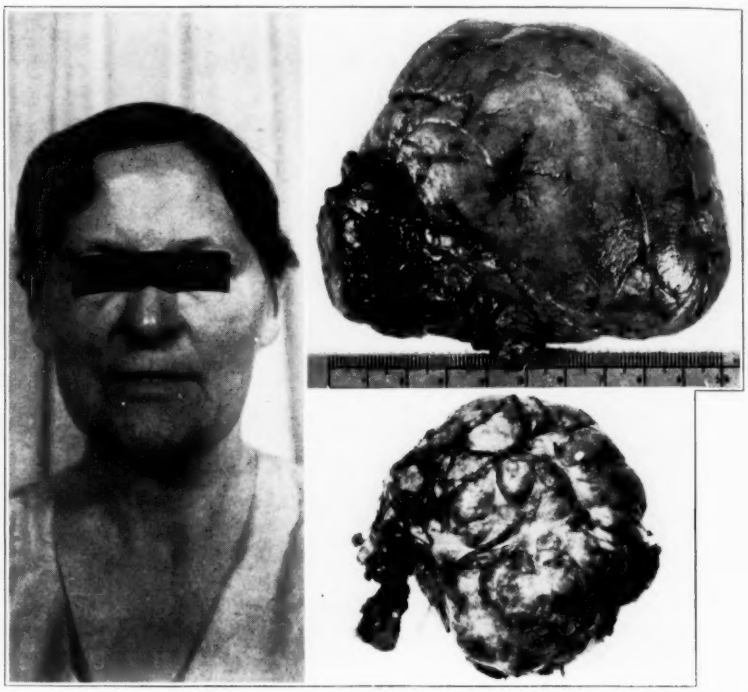

Fig. 17 (case 12).—The picture on the left is a view of the patient taken after the second operation. The upper one on the right shows the primary tumor with a relatively smooth surface and with the capsule intact except in one area; grossly, it does not appear particularly vascular. The lower picture on the right shows the recurrent tumor in this case. Grossly, this tumor appears a little different from the first, and has the typical lobulated appearance of a fibroblastoma.

21, 1927, with the following history: In 1899, he was struck in the frontal region by a falling tree and rendered unconscious for twenty-four hours. From that time until 1924, he had repeated attacks of headaches. On March 8, 1924, he had the first of twelve general convulsions with loss of consciousness. Preceding the attacks there was a premonition: He felt dazed, missed his aim when reaching for objects and was unable to speak. The attacks began with twitchings of the right

hand and then involved all four extremities. From 1924 to 1927, he noticed increasing difficulty in concentration; his attention wandered; he had difficulty in spelling, could not distinguish between the right and the left foot, made mistakes in sorting the mail, and for the past two months made errors in subtraction and addition.

Examination.—Neurologic examination revealed a defective memory for events of the past three years.

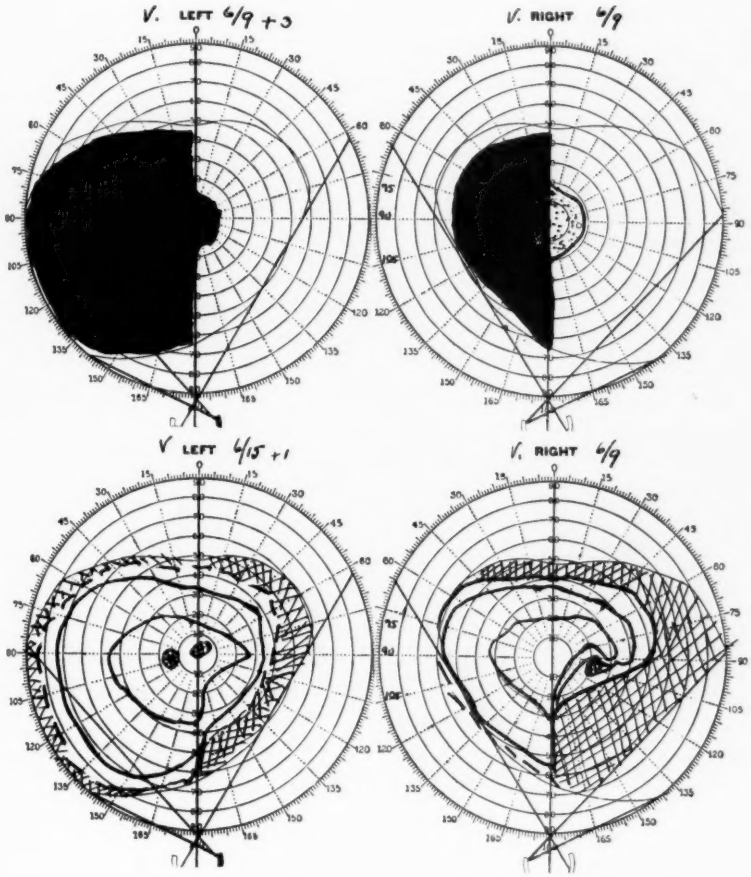

Fig. 18 (case 13).—The upper part is a preoperative view of the visual fields taken on March 8, 1927, showing a right homonymous hemianopia with retention of central vision. The lower part is a postoperative view taken on June 15, 1932, showing a rather pronounced expansion of the fields, only a quadrantic defect still remaining in the right temporal field.

There was slight impairment of the sense of position in the right lower extremity and to some extent in the right upper extremity.

There were no motor disturbances.

The patient talked deliberately, but forgot names of familiar objects and persons.

There was a right homonymous hemianopia with preservation of some central vision. The disks presented a papilledema of plus 4.5 diopters (fig. 18).

The pressure of the cerebrospinal fluid was 325 mm.; serologic tests gave negative results.

The sella turcica measured 14 by 11.5 mm. There was a calcified shadow in the left occipital area, with some thickening of the overlying skull.

The preoperative diagnosis was tumor of the occipital lobe with extension into the parietal lobe.

Operation and Course.—A left craniotomy was performed on March 18, 1927, under local anesthesia; closure was performed under ether. A flap was reflected

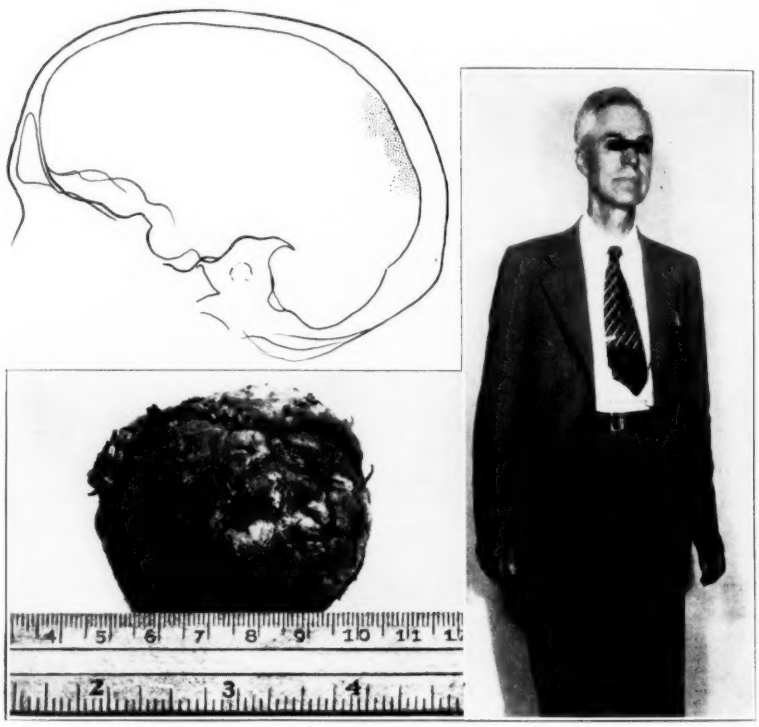

Fig. 19 (case 13).—The diagrammatic sketch shows calcification in the left occipital region with some thickening of the overlying skull. The photograph of the tumor removed shows a typical meningeal fibroblastoma. The photograph of the patient was taken five years after operation.

to expose the region of the calcified shadow and extended to within 2 inches (5 cm.) of the occipital protuberance. The tumor was exactly in the middle of the cranial opening and presumably took its origin from the dura. An area of the dura, 4 cm. in diameter, was removed with the tumor. The tumor was removed intact and in toto. The dural defect was replaced with a fascial graft from the patient's leg (fig. 19).

The pathologic diagnosis was meningioma.

Recovery occurred promptly. The patient reported for reexamination of his own volition on June 15, 1932, five years and three months after the operation. He had resumed his former occupation and so far as he knew was symptom-free. His vision was 5/6 in each eye, and the fields still showed a right homonymous cut, though not as extensive as before the operation.

PATHOLOGY OF MENINGEAL FIBROBLASTOMAS

Distribution.—Most of our cerebral fibroblastomas were found in the anterior half of the brain, particularly in the frontal, precentral and temporal regions. Of the seventy-five tumors over the convexities, fifty-eight, or 77 per cent, were in this general region. Their incidence over the anterior half of the hemispheres is more than accidental, because a similar distribution was found by Cushing.[2] The difficulty lies in finding an adequate explanation for this predominance of geographic distribution in the anterior half of the cerebrum. If we accept the derivation of these tumors from the arachnoidal villi and the pacchionian granulations (Schmidt,[3] Cushing[2] and Cleland[4]), their distribution in these regions becomes undesirable in part, owing to their close relationship to the venous sinuses and the arachnoid villi. We must hypothecate, nevertheless, a predominance of these villi in the anterior half of the superior longitudinal sinus in order to explain their greater incidence in the frontal areas, as compared, for example, with the parietal and occipital regions. So far as we know, no studies have been made which prove this inequality of distribution, but we may, for the moment at least, accept the fact that this may be so in view of the intimate association of the fibroblastomas with the arachnoid membrane. It is difficult to explain, however, the cases of fibroblastoma which show no relationship to the venous sinuses, and which, if one can judge from their position in situ, are not in intimate association with the arachnoid villi. These may arise from arachnoidal cell clusters which invade the dura, but not in the region of the sinuses. Such clusters of cells have been found by Weed.[5]

GROSS FEATURES OF FIBROBLASTOMAS

General Characteristics.—The cerebral fibroblastomas are encapsulated tumors which lie on the surface of the brain. Rarely, they lie

2. Cushing, H.: The Meningiomas (Dural Endotheliomas): Their Source and Favored Seats of Origin, Brain **45**:282, 1922.

3. Schmidt, M. B.: Ueber die pacchionischen Granulationen und ihre Verhältnis zu den Sarcomen und Psammomen der Dura Mater, Virchows Arch. f. path. Anat. **170**:429, 1902.

4. Cleland, J.: Description of Two Tumors Adherent to the Deep Surface of the Dura Mater, Glasgow M. J. **11**:148, 1864.

5. Weed, L. H.: The Cells of the Arachnoid, Bull. Johns Hopkins Hosp. **31**:343, 1920.

within the brain substance itself (Alpers, Grant and Yaskin [6] and Petit-Dutaillis and Bertrand [7]). They are located chiefly in the anterior portion of the hemispheres, in close relation to the pacchionian bodies. Thus, they are found more frequently near the longitudinal sinus and the lateral fissure than elsewhere over the hemispheres (Cushing [2]). In our series of cases the tumors were located chiefly in these areas and along the sinuses in the occipital regions. They are encapsulated, being surrounded by a thin fibrous capsule which envelops the entire tumor. Their size varies from very small tumors weighing only 10 Gm. to huge tumors weighing as much as 310 Gm. Usually they are more or less round, but they may be flattened, ovoid, or heart-shaped. Their surface is lobulated, the lobules often being large and giving the tumor a potato-like aspect. Sometimes the entire surface has a finely lobulated contour. Rarely, the tumors have a perfectly smooth contour. They may be firm, even hard, or quite soft in consistency. Not infrequently they are cystic tumors, sometimes one half of the growth being cystic in structure. Often small cysts are scattered through the tumor tissue. In the capsule, coursing over the surface of the tumor, are many blood vessels which vary in size and number. As a rule, they are abundant even in the less vascular tumors. One of the most interesting features of these tumors lies in their adherence to the overlying dura. This may vary in firmness in various cases, some being so adherent that they cannot be separated without tearing the tumor, and others peeling away easily from the dural attachment. In every instance a cerebral fibroblastoma is attached to the overlying dura.

The cut surfaces vary widely. Some are granular or wartlike in appearance; others are rather homogeneous with cysts scattered through their structure, and still others are densely fibrotic, the coarse fibrous structure being apparent even to the naked eye. Blood vessels vary in number, but, as a rule, large blood channels may be seen penetrating the tumor in many places. The color of the tumor is sometimes a fleshy red, and at others a yellowish white, depending probably on the number of blood vessels, and on the amount of fibrous structure within the tumor. Sometimes the tumors are merely a flat sheet, adherent to the dura. In such cases they are usually spoken of as flat meningiomas or fibroblastomas.

Fibroblastomas are slowly growing tumors which, as they expand, push the brain tissue before them, without invading the brain substance.

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6. Alpers, B. J.; Grant, F. C., and Yaskin, J. C.: Primary Fibroblastomas of the Brain, Arch. Neurol. & Psychiat. **27**:270 (Feb.) 1932.

7. Petit-Dutaillis, D., and Bertrand, I.: Fibroblastome profonde, intracérébrale de l'hémisphere gauche, Rev. neurol. **39**:96, 1932.

They never penetrate the pia, which lies beneath them. As they grow, the brain tissue gives way before them, and in time the tumor forms a good-sized bed. This depression may be marked, so that on removal of the tumor the extent of the cerebral compression may be a matter of great surprise. Usually the cerebral fibroblastomas are unilateral, but when they arise near the midline, along the longitudinal sinus, they may straddle the sinus and compress both hemispheres. In one instance in our series a huge fibroblastoma compressed both frontal lobes and almost completely obliterated them. In another case, a large flat tumor compressed both parietal lobes.

Multiple Fibroblastomas.—In the great majority of instances these tumors are single. On rare occasions they may be multiple. Hosoi [8] has recently reported on this type of tumor. Case 14 illustrates this.

CASE 14.—*History.*—C. S., a woman, aged 40, entered the University Hospital on Dec. 22, 1926, complaining of occipital headaches for one year. For eight months she had suffered with diplopia, following which loss of vision developed, until at the time of entrance she could make out only moving objects. For a year her memory had been failing. Weakness of the right arm and leg had developed during the past month, as well as pains in the right side of the face.

Examination.—There was only a slight weakness of the right side with a questionable Babinski sign on this side. The spinal fluid pressure was 20 mm. of mercury. There were 3 diopters of choking in the right eye and 3.5 diopters in the left. A roentgenogram revealed atrophy of the dorsum sellae and the posterior clinoids.

On Jan. 4, 1927, a ventriculogram showed obliteration of the entire ventricle on the right side. A diagnosis of a right temporoparietal tumor was made.

Operation and Course.—On Jan. 28, 1927, Dr. Frazier removed a small tumor lying 1.5 cm. behind the rolandic vein, and 3 cm. above the fissure of Sylvius.

The patient did not survive the operation.

Necropsy.—A large tumor was present also in the right occipital region. Both tumors were fibroblastomas.

Case 14 is the only example of multiple cerebral fibroblastomas in our series. That the tumor removed at operation was not part of a dumbbell-shaped mass is shown by the absolute distinctness of both tumors. There was no connection between them.

Hyperostoses.—In ten of our cases, or 13 per cent, fibroblastomas were accompanied by hyperostosis cranii. The subject has been recently reviewed by Alpers and Harrow,[9] but it may be of interest to indicate here some of the characteristics of these bony enlargements. In only two of the ten cases were there flat fibroblastomas. In both these cases the hyperostosis was marked.

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8. Hosoi, K.: Meningiomas with Special Reference to the Multiple Intracranial Type, Am. J. Path. **6**:245 (May) 1930.

9. Alpers, B. J., and Harrow, Reed: Cranial Hyperostosis, Arch. Neurol. & Psychiat. **28**:339 (Aug.) 1932.

Usually the bony enlargement is unilateral, immediately overlying the tumor, but it may be bilateral, particularly in tumors that straddle the midline. The extent of the bony enlargement varies. Some are only small knoblike swellings; others are large, extensive overgrowths of bone which may cover from a third to a half of the calvarium on one side. The nature of the bone varies. In some hyperostoses the bone is extremely dense and hard, having a solid surface which is as dense as ivory and difficult to cut. In others the bone is looser, spiculated and not particularly dense or hard. Often the bone is capped by a hillock of soft tissue which penetrates through the hyperostosis to get under the scalp. Sometimes fully half of what appears to be a hyperostosis may really be the soft tissue pad under the scalp. This was true in one of our cases in which a flat fibroblastoma compressed both parietal lobes and caused an immense turret-shaped hyperostosis.

The relation of the underlying fibroblastoma to the hyperostosis has been thoroughly investigated by Penfield [10] and need not be reiterated here. The inner surface of the skull in the areas of hyperostosis is often transversed by deep wide blood channels. Covering the inner table, too, are small barnacle-like excrescences, or burrs, of bone which in some instances may be spread over the entire inner table of the skull. These hyperostoses are usually near the vertex, but they may be present also at the base of the skull (Virchow [11]) or at any point over the calvarium. As a rule, however, they tend to be more common near the vertex.

In many instances the dura is markedly adherent to the overlying bone, and in some cases the adhesion is so firm that it can be separated only with great force.

The cause of the hyperostoses is of some interest. It is claimed by some that they are caused by an invasion of the skull by tumor tissue, this resulting in the production of bone by the stimulation of osteoblast action (Cushing [12]). Others believe that the bone proliferation occurs first in response to the early dilatation of blood vessels, and that tumor invasion follows later (Kolodny [13]). In some instances the hyperostosis may result from trauma, may precede the soft tumor formation and may

10. Penfield, W. A.: Cranial and Intracranial Endotheliomata: Hemicraniosis, Surg., Gynec. & Obst. **36**:657, 1923.

11. Virchow, R.: Die krankhaften Geschwülste, Berlin, A. Hirschwald, 1863-1867, vol. 2, p. 115.

12. Cushing, H.: The Cranial Hyperostoses Produced by Meningeal Endotheliomas, Arch. Neurol. & Psychiat. **8**:139 (Aug.) 1922.

13. Kolodny, A.: Cranial Changes Associated with Meningioma, Surg., Gynec. & Obst. **48**:231, 1929.

by irritation of the dura cause a soft tumor formation (Spiller [14]). The final conclusion concerning the mode of origin of these hyperostoses awaits further evidence. The theory of stimulation of osteoblasts into action by invading tumor cells cannot be substantiated in all cases; there are reported cases in which a fibroblastoma that invaded the bone was accompanied by thinning of the bone rather than by hyperostosis (Thompson [15]). Therefore, not always is invasion of the bone accompanied by hyperostosis. We are unable to state definitely, however, the exact cause of the cranial hyperostosis overlying some fibroblastomas.

ORIGIN AND CELL TYPE OF THE FIBROBLASTOMAS

It is now generally accepted that the meningeal fibroblastomas are derived from the arachnoid. The older idea that these tumors were dural endotheliomas has long been discarded. Virchow believed that they were dural in origin, though he pointed out that they were not so adherent to this membrane that they could not be separated readily. The similarity of the tumors to the structure of the arachnoid villi and cell clusters has been pointed out (Weed, Cushing and Cleland), and Schmidt has succeeded in tracing such a tumor back to its origin in an arachnoid villus. More recently, Casper [16] found rather clear transitions between the arachnoidal cell clusters and the meningeal tumors in three cases of multiple meningeal tumors over the convexities.

That these tumors therefore arise from the arachnoid rather than from the dura seems true. The evidence for this view has been reviewed by Casper, Penfield, Mallory [17] and others. We shall not reconsider it.

The question becomes, then, one of terminology and of determining the type cell of which these tumors are composed. Shall we accept the fact that the arachnoid is lined with mesothelium (Weed) or with fibroblasts (Mallory)? And shall we call these tumors meningiomas (Cushing and Bailey [18]), arachnoid fibroblasts (Mallory) or meningeal fibroblastomas (Penfield [19])?

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14. Spiller, W. G.: Cranial Hyperostosis Associated with Underlying Meningeal Fibroblastoma, Arch. Neurol. & Psychiat. **21**:637 (March) 1929.

15. Thompson, R. H.: Focal Enlargement of the Temporal Bone as a Sign of Brain Tumor, J. A. M. A. **99**:379 (July 30) 1932.

16. Casper, J.: Beiträge zur Pathologie der multiplen und diffüsen Endotheliome der Hirnhäute, Deutsche Ztschr. f. Nervenh. **96**:85, 1927.

17. Mallory, F. B.: The Type of Cell of the So-Called Dural Endotheliomas, J. M. Research **41**:349, 1920.

18. Bailey, P., and Bucy, P. C.: The Origin and Nature of the Meningeal Tumors, Am. J. Cancer **15**:15 (Jan.) 1921.

19. Penfield, W.: The Encapsulated Tumors of the Nervous System, Surg., Gynec. & Obst. **45**:178, 1927.

By those who accept the mesothelial concept of the arachnoid, no evidence is found for the existence of fibroblasts within this membrane. On the other hand, Mallory believes that the cells lining the arachnoid are all fibroblasts. We are forced, therefore, to accept one or the other view, and to make our ideas concerning these tumors conform to that particular view. There is some evidence that mesothelial cells are capable of producing fibroblasts through proliferation (Dominici,[20] Jolly [21] and Schott [22]). In the second of the meningeal tumors arising from the mesothelium, which Weed described in cats, there was "an extensive connective tissue framework." These tumors arose as a "proliferative phenomenon from the initially slowly growing arachnoid cell cluster." Presumably, all meningeal fibroblastomas develop either from these cell clusters which are found in the arachnoid in older persons, or from the arachnoid villi which resemble them closely in structure. Granting even that the cells lining the arachnoid are mesothelial cells such as line other serous membranes, there must be a capacity on the part of these cells to produce the products of fibroblasts, or we should have no connective tissue structure in the tumors described by Weed. It is likely, therefore, that the arachnoidal cells may assume the properties of fibroblasts, even though they may not to begin with themselves be fibroblasts. If this is so, then the experiments of Kredel [23] on cultures of meningiomas are not necessarily proof that fibroblasts do not constitute the cell type of these tumors. In his early cultures the cells resembled those of the "mononuclear macrophage series," the later ones assuming the cell characteristics of fibroblasts. That the reverse process, the formation of mesothelium from fibroblasts, may take place has been shown by Clarke [24] and Lewis.[25] The former found the flat cells of serous surfaces regenerating from deep connective tissue cells. The latter saw the fibroblasts in tissue cultures assume a squamous shape and a general structure typical for mesothelium. It is therefore possible either that the mesothelial cell may be a modified fibroblast, or that the latter may develop from it under pathologic conditions. It is not impossible to bring together the two views concerning the lining cells of the arachnoid by assuming a reversible capacity on the parts of these cells, the mesothelium assum-

20. Dominici, H.: Arch. d'anat. micr. **17**:3, 1920.

21. Jolly, J.: Traité technique d'hématologie, morphologie, histogenése, histophysiologie, histopathologie, Paris, Norbert Maloine, 1923.

22. Schott, E.: Arch. f. mikr. Anat. **74**:143, 1909.

23. Kredel, F. E.: Tissue Culture of Intracranial Tumors with a Note on the Meningiomas, Am. J. Path. **4**:337, 1928.

24. Clarke, W. G.: Experimental Mesothelium, Anat. Rec. **10**:301, 1915-1916.

25. Lewis, W.: Macrophages in Sterile Inflammation of Deep Fascia of Rat, Tr. Am. A. Anat. **32**:215, 1926.

ing fibroblastic properties and the fibroblasts forming at times mesothelial cells or cells which resemble mesothelium closely (fig. 20).

The fibroblastic nature of the meningeal tumor has been denied by Bailey, who believes that the fibroblast is not the type cell, and that these tumors form only one of a group of tumors derived from the meninges. This is in contrast to the views of Mallory and Penfield, who believe that all these tumors are fibroblastic.

Cushing, and following him Bailey, preferred the term meningioma as being noncommittal and yet sufficiently specific to indicate the meningeal origin of these tumors. Penfield preferred the term meningeal fibroblastoma because, as Elsberg has pointed out for the tumors of the spinal cord, not all these tumors have an arachnoidal attachment. The term fibroblastoma seems to us to be the most satisfactory; but we prefer the term meningeal fibroblastoma to arachnoidal fibroblastoma.

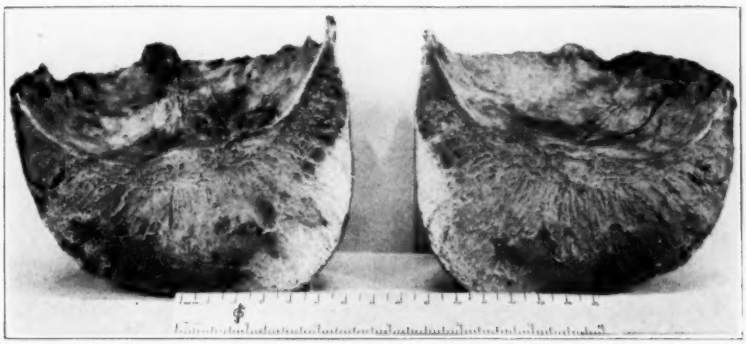

Fig. 20.—The tremendous hyperostosis with typical spiculation is seen in this case. The entire thickening, however, is not bony, almost half of the upper portion of the mass being tumor tissue.

RELATION OF THE FIBROBLASTOMAS TO THE MENINGES

Rarely, one finds fibroblastomas that are entirely extradural. We have such a case in our collection, a tumor in a child, aged 10, in which a relatively undifferentiated type of fibroblastoma lay on the dura and had no attachment whatever with the arachnoid. It was partly cystic and firmly adherent to the inner surface of the calvarium. Its meningeal nature was obvious, but it was a relatively undifferentiated type of tumor, showing a fine stroma of collagen and, in some areas, a dense fibrous tissue structure without elastin or fibroglia. The case assumes some importance in our understanding of these meningeal tumors, indicating as it does that there are such tumors which have no apparent relationship with the arachnoid but are wholly in contact with the dura.

It may be well at this point to consider the attachment of these tumors to the dura. The great majority of them are adherent to the under surface of the dura, and presumably to the arachnoid as well. Whether any lie under the arachnoid without visible contact with the dura, or whether any lie under the pia, as Elsberg has found in some cases of tumor of the spinal cord, is hard to say. Rarely, a tumor may lie on the outer surface of the dura, exhibiting no relationship whatever to the arachnoid, as in the case already cited.

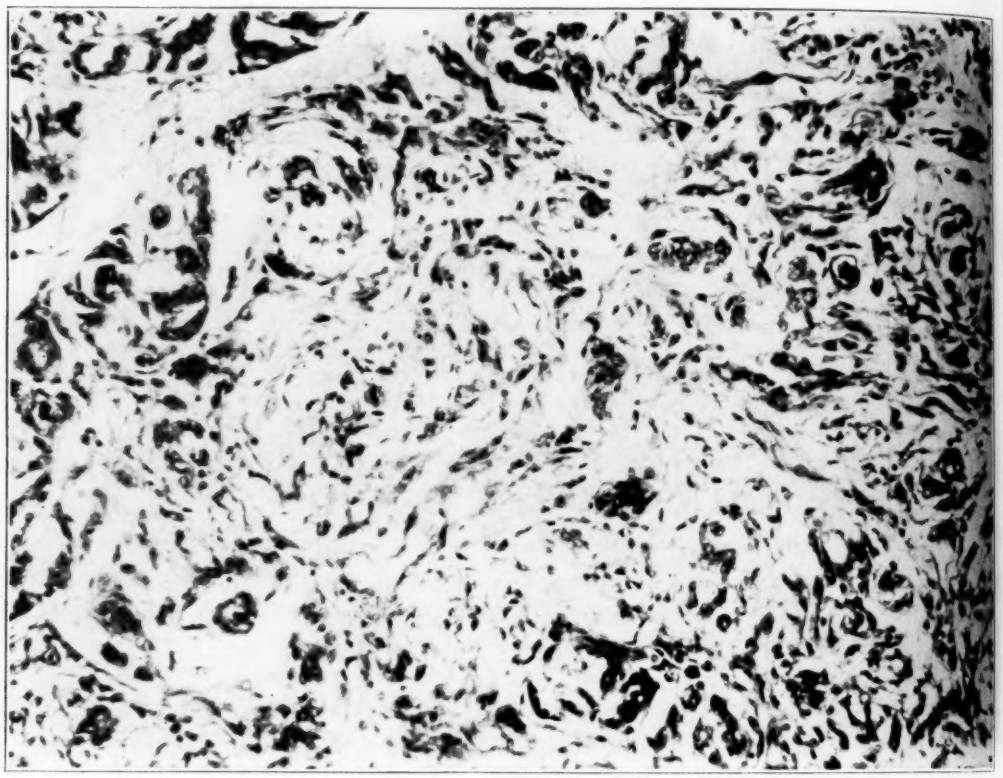

Fig. 21.—Photomicrograph showing relatively great cellularity with relative abundance of collagen, reticulin and fibroglia. It is a transition type.

There is a small group of fibroblastomas that lie entirely beneath the cortex and appear to be typical subcortical growths. They have no apparent connections with the dura, and they arise presumably from the pia, or from the arachnoid cells, which are carried into the cortex for a short distance when the pial vessels invade the cortical structures. We have three such cases in our series of tumors. These have the typical structure of a fibroblastoma. We are forced to look on these tumors

as arising primarily within the brain substance, since there is no demonstrable connection with the dura, and since they lie completely within the brain tissue and must be reached by means of a transcortical incision. We have previously reported a rather peculiar tumor of this type, with a tendency to a perivascular arrangement of the cells and indications of the origin of the tumor cells from the walls of the blood vessels.[6] The degree of adherence of the fibroblastomas to the dura is variable. Usually they are firmly adherent, but the dura can be stripped

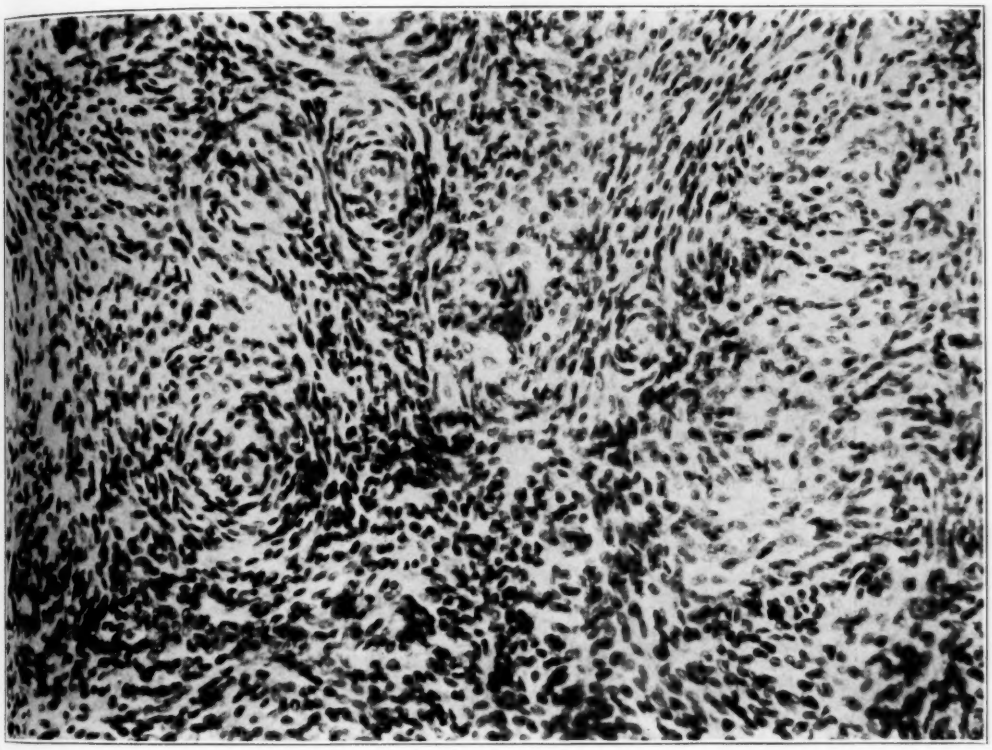

Fig. 22.—This type of tumor is cellular and undifferentiated. There is little collagen, and only scattered fibroglia fibrils. There is some tendency to whorl formation.

readily without tearing the tumor surface. In such cases the dura strips away cleanly. In rare instances, however, the dura is so firmly adherent to the tumor that it cannot be pulled away without carrying with it some of the underlying tumor. Microscopic examination of the dura in these cases of fibroblastoma has shown us that while the tumor is adherent to this membrane it does not necessarily follow that it invades it. We have found in the great majority of instances that the dura is

not invaded by the underlying tumor cells. Only occasionally have we found the dura invaded by fibroblastoma, and then never to any marked degree.

MICROSCOPIC DESCRIPTION

Uniform as the fibroblastomas appear in the gross, they have a widely varied structure histologically. They are almost as individualistic as the gliomas. Bailey and Bucy,[18] in fact, have divided the meningeal tumors into nine different types, which are as follows: mesenchymal, angioblastic, meningotheliomatous, psammomatous, osteoblastic, fibroblastic, melanoblastic, sarcomatous and lipomatous. They regard the

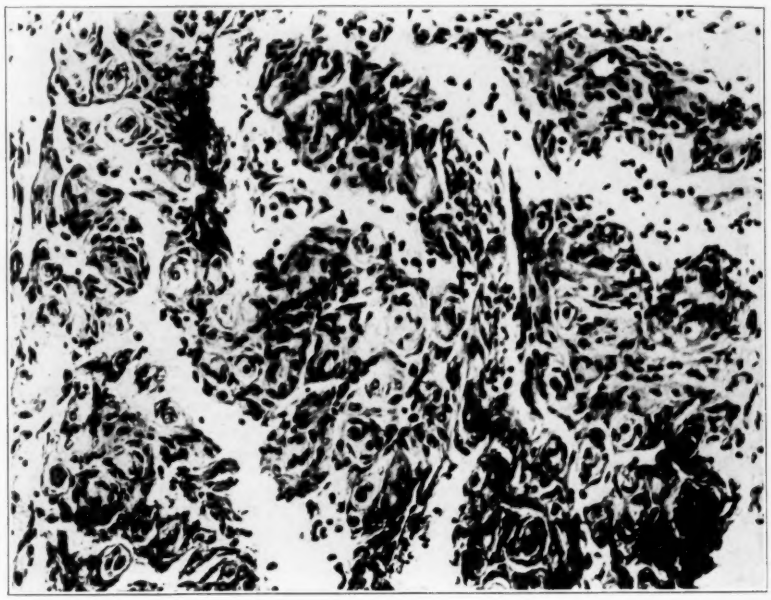

Fig. 23.—The psammomatous type of tumor is quite characteristic. Here the tumor is seen with the small precalcified whorls.

fibroblastic type as only one subdivision of the meningeal tumors, believing that the fibroblast is not the type cell of these tumors.

The cellularity of the fibroblastomas is not uniform. Some are densely cellular; others are less so. In some the arrangement in whorls is pronounced, in others absent. Stream formation is common, with cells running in many different directions through the tumor. Psammoma bodies are present either as an isolated feature or as a distinctive feature of certain tumors that are composed largely of these formations. The vascularity varies a good deal, some containing many blood vessels and others relatively few. In some tumors there is a

heavy framework of fibrous tissue which penetrates everywhere through the tumor structure. In others, this framework is not so complete, and is seen as rather dense connective tissue bands which penetrate among the tumor cells. A delicate stroma which can be demonstrated in silver preparations characterizes some tumors. This stroma penetrates everywhere, the cells lying in groups of varying numbers within its meshes. In still others the stroma is seen in silver and other preparations as a scanty framework in the immediate vicinity of the vessels.

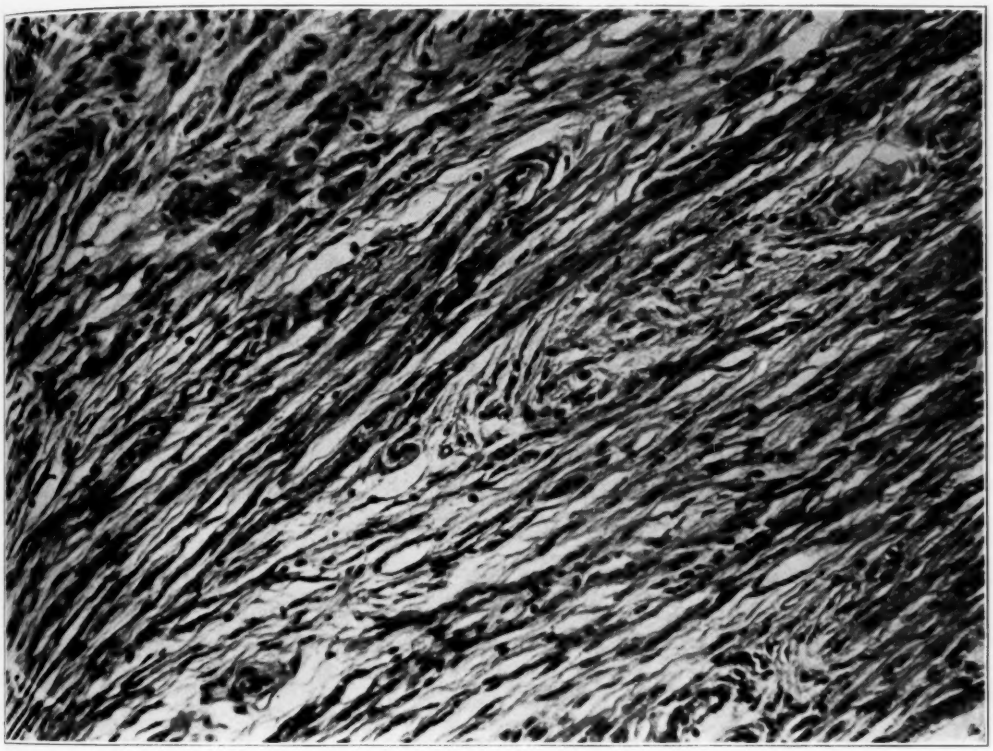

Fig. 24.—In this tumor, cells are fewer and intercellular tissue is much more abundant. There are numerous fibroglia and collagen fibrils.

Fibroglia can be demonstrated in many of the tumors. When it is not possible to see these fibrils with the usual dyes, they may often be demonstrated within the tumor cell by means of silver carbonate preparations. Here they appear as fine refractile fibrils, which often lie at the periphery of the cell and extend into its processes. We have been able to see such fibrils in silver preparations on careful search of the sections when they were not demonstrable by other means. In

some specimens it is entirely impossible to demonstrate fibroglia within the tumor. There is often a marked disproportion between the amount of connective tissue stroma and the fibroglia. Usually the former is much more abundant than the latter. Tumors are found, however, in which the fibrils may be entirely fibroglia. In silver preparations of del Rio Hortega the connective tissue elements are seen to be of three types: short, wavy, compact bundles of fibers which surround and envelop cells and groups of cells; long, hard, sweeping fibers which

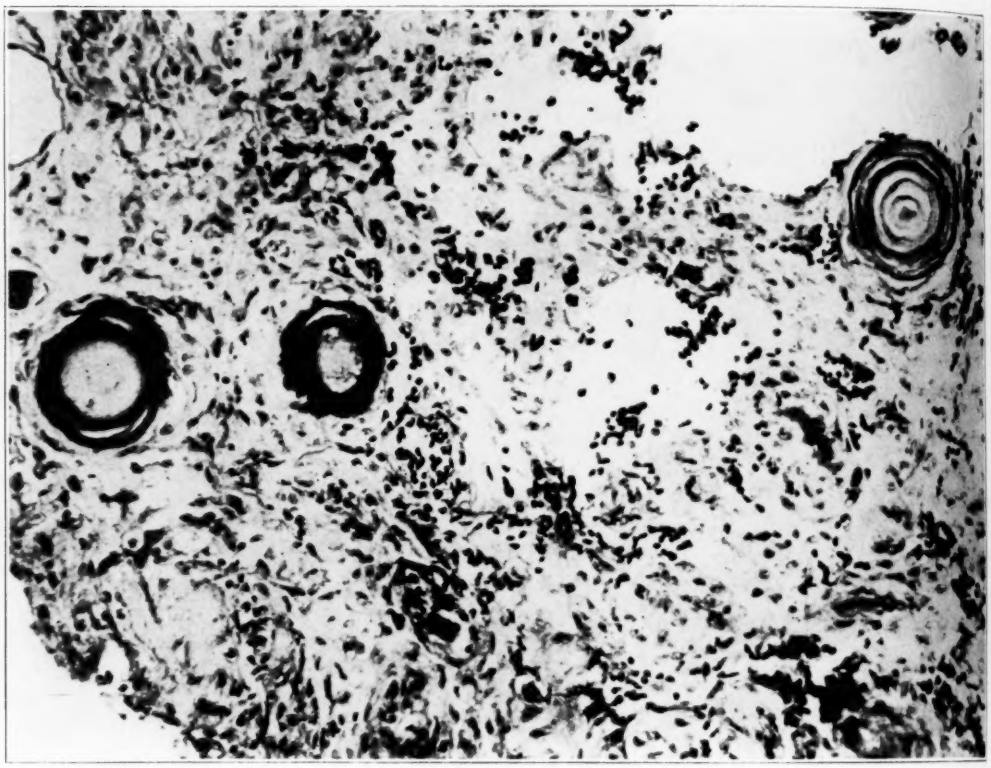

Fig. 25.—Psammoma bodies with calcification are present in this type of tumor.

course majestically everywhere through the tumor and interlace frequently, and delicate lacelike fibers which form a rather loose mesh throughout the tumor structures. The fibroglia in the silver preparations are seen as straight, hard, refractile, intracellular fibrils.

The reticulin preparations show no uniform structure of reticulin in any of the fibroblastomas. In the great majority of cases the reticular structure radiated out only for a short distance beyond the blood vessels.

but in none of our cases were we able to demonstrate a reticular framework which penetrated throughout the tumor.

In none of our cases could we demonstrate elastic tissue, though every tumor in the series was examined for elastic fibrils.

That there are several types of tumors which arise in association with the meninges cannot be questioned. Of these, the osteoblastic, melanoblastic, lipomatous and fibroblastic types represent to us the best defined classes. In our opinion the majority of tumors arising from the

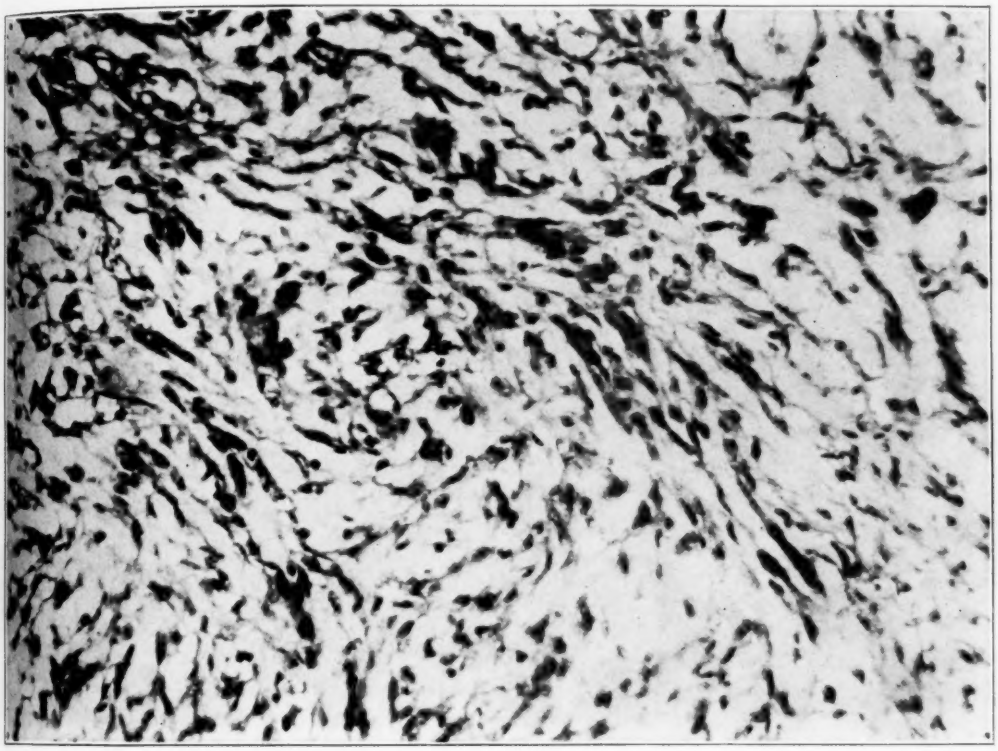

Fig. 26.—A similar type of tumor with a more fibrillar structure. It is slightly more differentiated.

meninges are fibroblastomas, the others representing rarer types. Any attempt to subdivide the fibroblastomatous group seems to us unnecessary if one accepts their origin from fibroblasts and views the differences in their structure as the result of greater or lesser differentiation. Thus, there is a group of these fibroblastomas which are well differentiated, with a good fibrous tissue, vascular and fibroglial structure. Others are less well differentiated, either with a rich fibrous stroma and a poor

fibroglial structure, or with no fibroglial structure at all. The psammomatous tumors seem to represent a fairly well defined group, and their subdivision from the main group of fibroblastomas seems to us to be justifiable.

We favor the view that the majority of the meningeal tumors are fibroblastomas, that they are in fact derived from fibroblasts, and that their difference in structure may be explained on the basis of greater or lesser differentiation of the products of these fibroblasts.

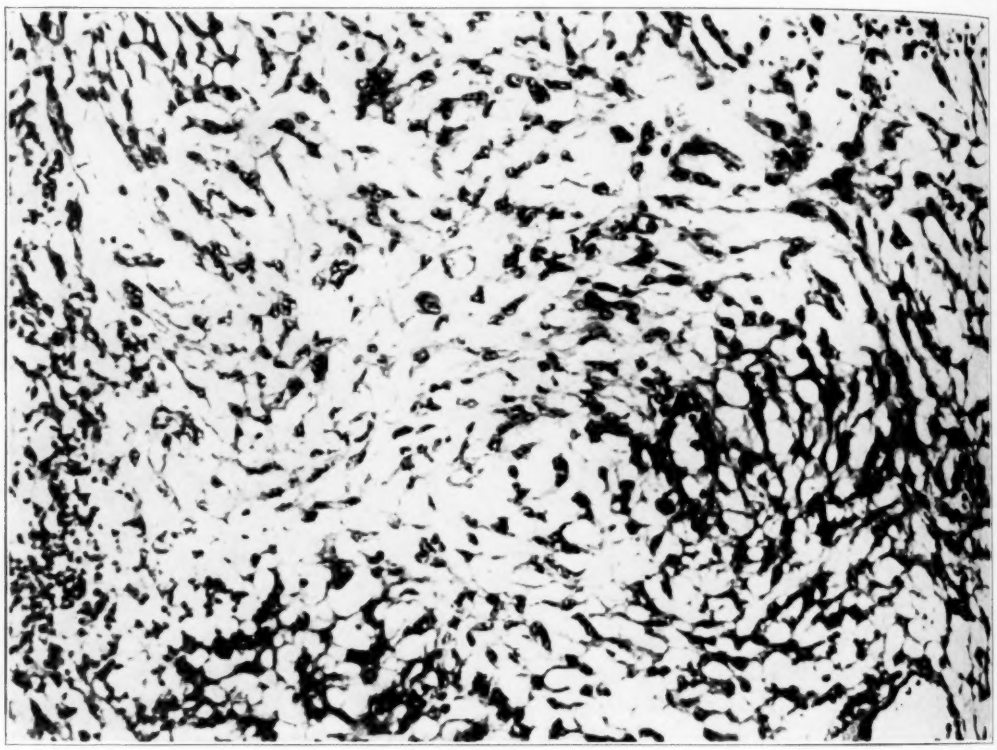

Fig. 27.—A loose-meshed type of tumor with a reticular structure, not much collagen and a relative abundance of fibroglia. It is a fairly well differentiated tumor.

CONCLUSIONS

1. A group of seventy-five meningeal fibroblastomas is analyzed with respect to the clinical and pathologic features.

2. Most of the tumors were located over the anterior half of the brain.

3. There were twenty-two frontal fibroblastomas. Among these have been identified four types of syndrome. There is no picture

common to all the frontal fibroblastomas. Mental symptoms were lacking in three fifths of the cases.

4. In the eighteen precentral fibroblastomas weakness and motor jacksonian attacks were important aids in diagnosis.

5. Eighteen fibroblastomas were over the temporal lobes. Only eight caused weakness or hemianopia, and two aphasia.

6. Eight tumors were over the parietal lobes. Sensory jacksonian attacks and astereognosis were helpful in establishing a localization.

7. Of the nine tumors of the occipital lobe, four caused hemianopia and four aphasia. Attention is called to the relative intactness of central vision in cases of tumors of the occipital lobe, as contrasted with cases of tumor of the temporal lobe in which central vision is usually implicated.

8. From the pathologic standpoint, we favor the term meningeal fibroblastoma, calling attention to the fact that these tumors do not arise in every instance from the arachnoid. We favor their derivation from fibroblasts in most instances, admitting the occurrence of other forms of meningeal tumors, such as lipomas and osteomas. We report a case of multiple fibroblastoma. Finally, we call attention to the problem of hyperostoses in the fibroblastomas, reporting an instance of thinning of the overlying bone, with invasion of the bone by tumor cells, casting some doubt on the hypothesis that the hyperostoses are due to proliferation of osteoblasts under stimulus of the invading tumor cells.

ENCEPHALOPATHIA ALCOHOLICA

(POLIOENCEPHALITIS HÆMORRHAGICA SUPERIOR OF WERNICKE)

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Acute and chronic alcoholic intoxications produce a variety of clinical pictures which are fairly well differentiated from each other. This paper will deal principally with the so-called polioencephalitis haemorrhagica of Wernicke. This condition may be associated with polyneuritis, and there are many associated but atypical pictures, at least if one considers Wernicke's classic description. More recent investigations, especially those of Gamper,[1] Ohkuma [2] and Neubuerger [3] disclosed the relation of polioencephalitis to other alcoholic psychoses. In the classic picture of polioencephalitis the following characteristics have been emphasized; ocular palsies, deep clouding of consciousness, asynergia and toxic changes. Alcohol has been shown to be important in the etiology, but Oppenheim [4] and Neuberger [3] have found that influenza and other conditions may produce the same picture. Small hemorrhages in the ventricular gray areas and around the oculomotor nuclei were found long ago in cases of chronic alcoholism by Raimon.[5] As Schroeder [6] has suggested, there is no encephalitis in the proper sense, but degenerative changes occur in the blood vessels and are associated with hemorrhages. Walthard [7] and Ohkuma,[2] however believed that an inflammatory process may also be present. Gamper [1]

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1. Gamper, E.: Zur Frage der Polioencephalitis hemorrhagica der chronischen Alkoholiker, Deutsche Ztschr. f. Nervenh. **102**:122, 1928.

2. Ohkuma, T.: Zur pathologischen Anatomie des chronischen Alkoholismus, Ztschr. f. d. ges. Neurol. u. Psychiat. **126**:94, 1930.

3. Neubuerger, Karl: Ueber Hirnveränderungen nach Alkoholmissbrauch, Ztschr. f. d. ges. Neurol. u. Psychiat. **135**:322, 1931.

4. Oppenheim, H.: Lehrbuch der Nervenkrankheiten, ed. 7, Berlin, S. Karger, 1923.

5. Raimon, quoted by Oppenheim,[4] p. 1304.

6. Schroeder, quoted in Bumke, O.: Handbuch der Geisteskrankheiten, Berlin, Julius Springer, 1930, vol. 11.

7. Walthard and Luethy: Ueber Polioencephalitis hemorrhagica superior, Ztschr. f. d. ges. Neurol. u. Psychiat. **116**:404, 1928.

claimed that a Korsakoff syndrome was often present in such cases. As is to be expected, polyneuritic signs are often found with lesions of the central nervous system such as are present in Wernicke's polioencephalitis. Pseudo-pellagrous lesions of the skin have been observed in patients with chronic alcoholism by Klauder and Winkelman [8] and by Boggs and Padget.[9] This is an interesting association that is not mentioned in the German literature, except that Kumer [10] observed some endemic cases of pellagra among alcoholic patients. A number of our cases have shown these cutaneous lesions also. This raises the more general question as to whether the polioencephalitis, as well as polyneuritis, may not be an expression of a general trophic change, or whether the trophic changes may result from lesions of the vegetative centers of the central nervous system and thus be an expression of a vegetative polyneuritis.

We shall not attempt here to deal with other interesting types of chronic alcoholic disturbances, although we may mention that of one of us (Dr. Schilder [11]) has shown that lesions of the striopallidum and substantia nigra in chronic alcoholism are evidenced by flexor contractures in the outstretched arms with convergence at the elbows. These changes may be associated with alcoholic tremor, but may also be independent of it. In acute and chronic alcoholism one may also see pictures that closely resemble paralysis agitans. The various neurologic problems offered in delirium tremens cannot be considered here. These may include strio-pallidum and midbrain syndromes as well as the well known cerebellar syndrome.

An analysis of the present series of cases, which were studied in the psychopathic division of the Bellevue hospital, has led us to make a classification into five clinical groups. The first of these comes nearest to the classic picture of polioencephalitis haemorrhagica superior, with clouding of consciousness and changing rigidities in the limbs as characteristics. In the second group cerebellar disturbances are more prominent. The third group closely resembles acute catatonia in both mental and neurologic features. In the fourth group the delirious features are more marked and the neurologic features less so. In the fifth group polyneuritic signs are associated with various polioencephalitic signs.

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8. Klauder, J. V., and Winkelman, N. W.: Pellagra Among Chronic Alcoholic Addicts, J. A. M. A. **90**:364 (Feb. 4) 1928.

9. Boggs, T. R., and Padget, Paul: Pellagra, Bull. Johns Hopkins Hosp. **50**:21, 1932.

10. Kumer, H.: Ueber versprengte Pellagra in Tirol, Wien. klin. Wchnschr. **44**:849, 1931.

11. Schilder, P.: Convergence Reactions, Especially in Alcoholics, J. Nerv. & Ment. Dis. **71**:1, 1930; Paralysis Agitans Pictures in Alcoholics, ibid. **76**:586, 1932.

I. ENCEPHALOPATHIA ALCOHOLICA WITH CLOUDING OF CONSCIOUSNESS AND CHANGING RIGIDITIES

CASE 1.—*Clinical History.*—A man, aged 45, had been drinking heavily and neglecting himself completely for several weeks before admission to the hospital on Oct. 8, 1929. He answered questions briefly at first, but immediately became drowsy. His speech was slurred. There was deep clouding of consciousness, with marked restlessness at night. He was continually grabbing at objects; he pulled at his shoes, and tried to catch things. There was no psychic resistance, and there was an increased reaction to pain. He tried again and again to get up, but fell back, and there was a dissociation between the activities of the limbs and the trunk. There were no lasting rigidities but a frequently recurring and changing resistance to passive movements. Often, when the legs were extended and flexed he would continue the movement rhythmically. There were restless movements of an athetoid type, together with Dupuytren's contractures of the fingers. The neck and jaw were stiff against passive movements. There was paresis of the right internal rectus muscle. Pupillary, conjunctival and corneal reflexes and the eyegrounds were normal. Arm tendon and abdominal reflexes were present and equal; the left patellar reflex was also normal, but the right one was diminished; both achilles reflexes were absent. There was no Babinski reaction on either side. There was no change in the clinical picture in the next few days. The changing rigidities were always present. Death occurred on October 19. Postmortem examination showed pneumonia of the left lung, a pial edema and congestion of the brain.

Histopathologic Studies.—These included a complete study of the brain stem (fig. 1) and selected areas from the cerebral and cerebellar cortex.[12] A section through the medulla at the level of the nuclei of the eighth to the twelfth nerves, inclusive, showed ependymitis [13] with an underlying invasive gliosis, and beneath that there was congestion with small hemorrhages. This reaction invaded the nuclear masses, especially in the nucleus of the eighth nerve beneath the lateral recess of the fourth ventricle. A section through the posterior quadrigeminate body and the pons at the level of the red nucleus and the nucleus of the fourth nerve also showed ependymitis of the aqueduct, with many hummocks in the ependyma and a marked reaction in the lumen. Beneath this there was an increase in the vascular bed, with budding of the capillaries and small hemorrhages that involved the region of the nucleus of the fourth nerve and the fasciculus longitudinalis posterior. There was also a similar vascular reaction in the dome of the quadrigeminate bodies. About the recess between the pons and the red nucleus were perivascular hemorrhages with some reactive gliosis. A section through the third ventricle at the level of the cerebral peduncles showed the same type of ependymal reaction with a mild gliosis underlying it and a deeper lying vascular disturbance which involved the ventricular gray areas and isolated areas of the subthalamic nuclei and substantia nigra. In contrast, the adjacent white areas, such as the cerebral peduncles, were free from lesions. The larger vessels were usually surrounded by hemorrhages, a local softening or a glial wall. In an adjacent section through the anterior part of the putamen and the cortex of the insula,

12. Part of the histopathologic study of this investigation was made possible by the courtesy of the Neuropathological Department of the Neurological Institute of New York.

13. The term ependymitis is used here not in the sense of an inflammatory process but in the classic sense of a reactive process in the ependymal glia cells.

there were many areas of small hemorrhages, thickening of small vessels and perivascular softening. Sections through the third ventricle and the mammillary bodies showed the same ependymal reaction, but it was more severe. The thickening of the ependyma was from 50 to 100 microns, with underlying vascular and glial reactions, and was most severe in the mammillary bodies (fig. 2). These bodies were almost entirely replaced by the vascular organization, hemorrhages and new capillaries; the glial reaction was less pronounced. Many nerve cells had undoubtedly been lost, but those that persisted still appeared fairly healthy. The adjacent tissues were more or less normal, except that about the larger vessels

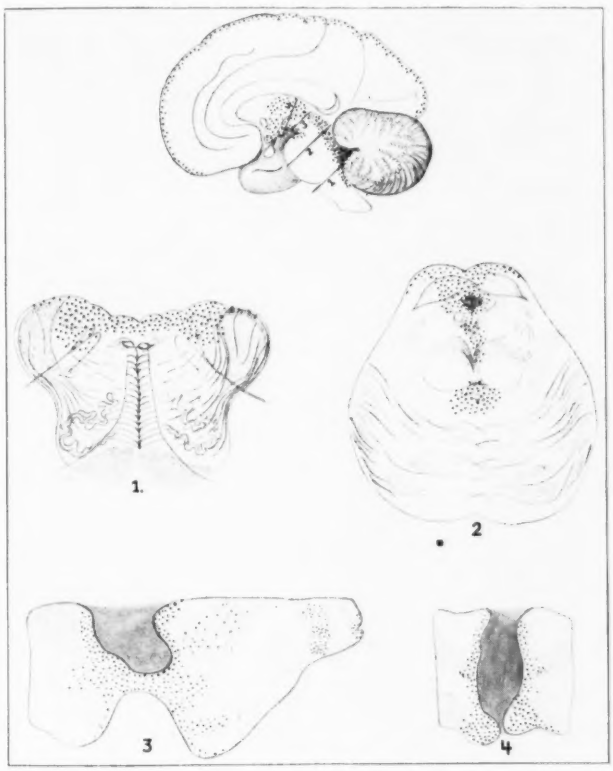

Fig. 1 (case 1).—Appearance of the brain stem.

in the anterior thalamic nucleus on one side there were some gliosis and phagocytosis. Sections of the cerebral cortex were entirely free from lesions in the white areas and deeper gray layers, but there were subpial hemorrhages and other vascular disturbances in small areas, especially where the pial membrane dipped into the convolutions. Here there were capillary budding, diapedesis and vacuolization of the tissue, with a marked invasion of large cytoplastic glia cells (fig. 3). Scharlach R stains showed fatty degeneration of the larger nerve cells, with fatty deposits in the phagocytes that surrounded many of the blood vessels. Nissl changes in the larger nerve cells were not marked. There was also thickening of the pial and subarachnoid membranes, and the meningeal vessels were engorged.

The optic nerve showed a marked increase in the blood vessels and trabecular and perivascular connective tissue. There was a severe marginal gliosis of the fibrous type. Also, throughout the nerve tract there was replacement of a large part of the myelinated nerve fibers by a coarse network of glial fibers interspersed with large glia cell bodies.

Summary and Comment.—The characteristic lesion was a ventricular ependymitis, with an underlying vascular disturbance which invaded all the ventricular gray masses. Similar lesions were seen on the surface of the brain, but they were less

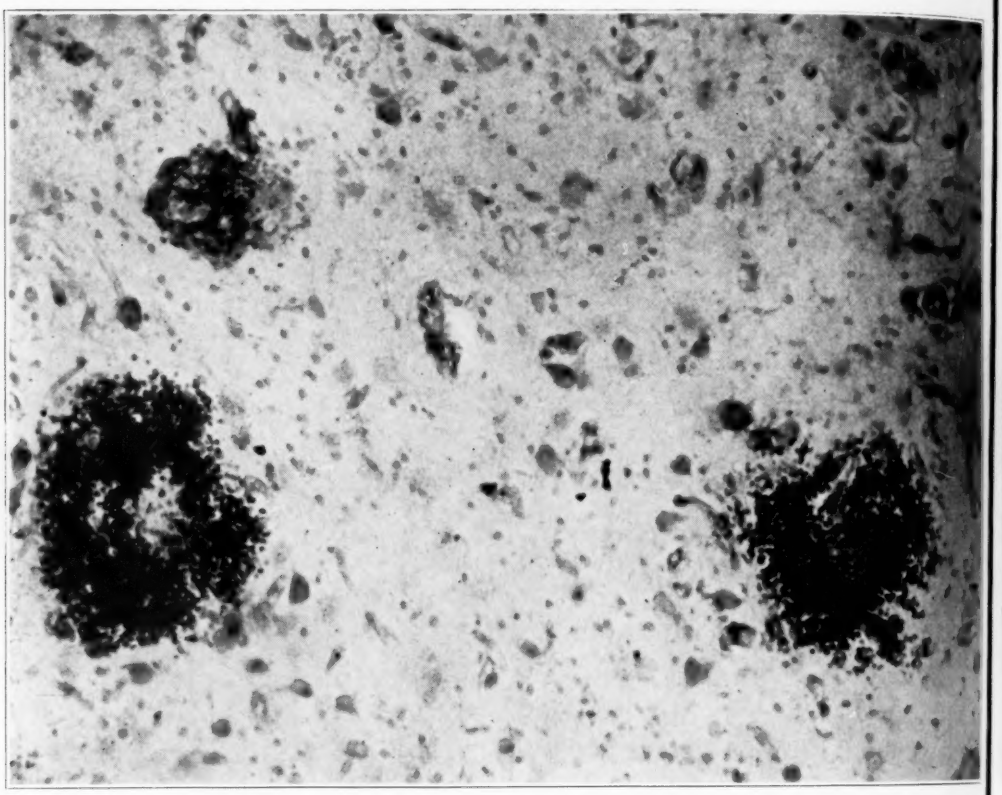

Fig. 2 (case 1).—A section from the mammillary body showing three perivascular hemorrhages as well as some scattered red blood cells in the upper right-hand corner. The small vessels within the center of the hemorrhages are clearly seen. The walls of the vessels show proliferative but no definite degenerative changes. Budding of the capillaries is also shown. The parenchymatous tissue is fairly normal. This field is typical for the whole of both mammillary bodies. Nissl stain; reduced from × 250.

severe. The optic nerve was also involved. Diffuse fatty changes were present in the nerve cells of the cortex. Three principles seemed to be involved in the localization of the lesions: 1. All surfaces of the central nervous system closely associated with the spinal fluid were affected, especially where there was a ten-

dency toward stagnation of the fluid. Thus the ventricular system, especially about recesses and pockets, was more involved than the surface of the brain. 2. Nuclear areas were more prone to lesions than adjacent white areas. This was seen both in the cortex and in the brain stem. 3. Visceral nuclear areas seemed more vulnerable than somatic or cortical nuclear areas.

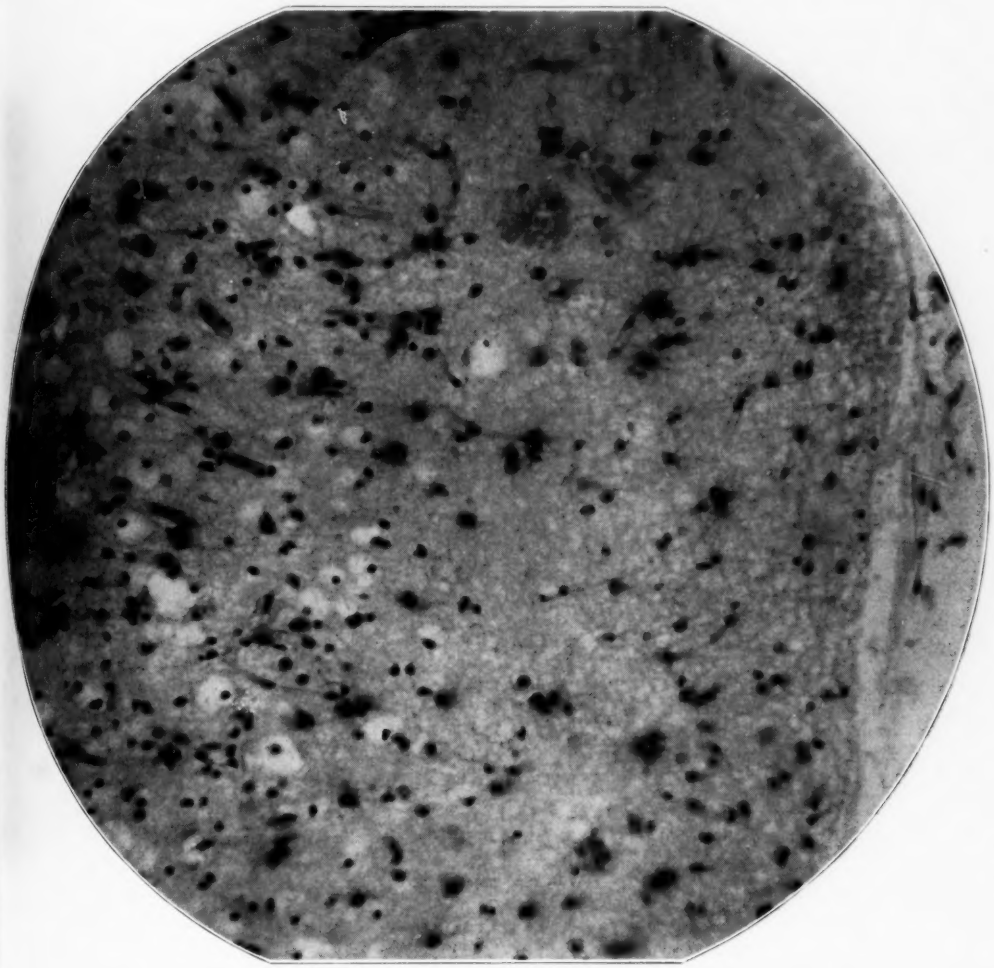

Fig. 3 (case 1).—Surface of the cortex including the pial membrane on the right and the first and second cortical layers on the left. There are a subpial hemorrhage (upper right-hand corner) and several smaller perivascular hemorrhages in the first and second layers (especially on the extreme left). There is a slight subpial astrocytic gliosis on the margin of the first layer and numerous large vacuolar spaces in the second layer which represent cytoplastic glial forms or swollen oligodendroglia. Vascular budding is also present. Nissl stain; reduced from × 250.

The outstanding clinical features were: (1) clouding of consciousness with delirious features; (2) a tendency to rhythmic movements; (3) athetoid movements; (4) changing rigidities; (5) grasping and groping; (6) paresis of the right internal rectus muscle; (7) asynergia between the legs and trunk, and (8) increased reaction to pain.

The lesions in the brain were so widespread that it is difficult to correlate accurately the clinical and anatomic findings. But it is probable, as we shall show later, that the clouding of consciousness was associated with lesions of the ventricular gray areas; the rigidities and athetoid movements, with lesions around the nucleus of the eighth nerve, the subthalamic region and the substantia nigra and putamen.

Case 2.—*Clinical History.*—A woman, aged 48, was transferred to the hospital on June 21, 1931, from another hospital, with the history that her husband had died three months before and that she had taken to drink. She had complained of gastritis and melancholia; for three days she had been in bed and had refused to get up; in general, she was very negativistic. She did not answer questions. She had a dazed expression, and her eyes rolled about, without fixing on anything. She responded to painful stimuli only slightly, by restless movements. There were changing rigidities in the limbs. Her temperature was 101 F.; no pathologic condition was found in the heart, lungs or abdomen to account for the fever. She had a tense expression of pain on her face and was blindly resistive to all examination procedures. The neck was rigid; the pupils were irregular and small, the left being fixed to light and the right one nearly so. The tendon reflexes of the arms were present and equal, but the knee and ankle jerks were absent. The abdominal reflexes were also absent. The Kernig sign was present on the right. Lumbar puncture showed clear fluid without increased pressure; it contained no cells or globulin, and the Wassermann and colloidal gold reactions were negative. Urinalysis gave negative results.

On June 22, she was more stuporous, did not talk, moaned, was resistive, was unable to swallow and showed a complete ophthalmoplegia. The temperature was 104 F., but there were no foci of infection, and the medical consultant related the fever to the cerebral disturbance. She died on this day. The anatomic findings at autopsy were: chronic mitral valvulitis, calcification and arteriosclerosis of the aortic valve leaflets, fatty infiltration of the liver, chronic interstitial hepatitis, chronic diffuse nephritis and congestion and edema of the brain.

Histopathologic Studies.—The brain stem (fig. 4) and selected areas of the cerebral and cerebellar cortex were examined. A section through the upper end of the cervical cord showed gliosis of the central canal and some marginal gliosis. There were also some thickening of the vessel walls and enlargement of the perivascular spaces, especially of vessels entering the gray matter from the region of the central canal. A section through the medulla showed ependymitis of the floor of the fourth ventricle, with underlying capillary congestion invading the nucleus of the eighth nerve. The same lesion was shown at the level of the nucleus of the sixth nerve. A section through the pons, at the level of the nucleus of the fourth nerve, showed the same lesions, with more extensive generalized congestion and numerous small hemorrhages. The lesion here was severe and involved the fasciculus longitudinalis posterior, the locus caeruleus and the nucleus of the fourth nerve (fig. 5). A section through the third ventricle (fig. 6), posterior to the mammillary bodies, showed ependymitis of the ventricular wall with an underlying fresh gliosis, and a severe hemorrhagic reaction deeply involving the thalamus, subthalamus and substantia nigra. At the level of the mammillary bodies the same lesion was seen, with a severe hemorrhagic, organizing and glial reaction almost entirely replacing

the mammillary bodies, although some nerve cells were still seen in the interstices of the adventitial tissues. Sections of the cerebral and cerebellar cortex showed a general capillary congestion in all parts, with occasional small hemorrhages. The special silver stains showed swelling and fragmentation of the microglia in all parts of the cerebral cortex. There was also a severe grade of fatty degeneration of the larger nerve cells.

Summary and Comment.—In general, the lesion had the same characteristics and distribution as that in case 1, but it was more severe and more acute, and there was a more generalized disturbance of the brain as a whole.

The outstanding clinical features were: (1) marked clouding of consciousness; (2) changing rigidities; (3) reduction in impulses, except negativistic ones; (4) ophthalmoplegia; (5) impaired reactions of the pupils to light, and (6) rapid febrile course. The changes in the brain were diffuse but very acute, being most

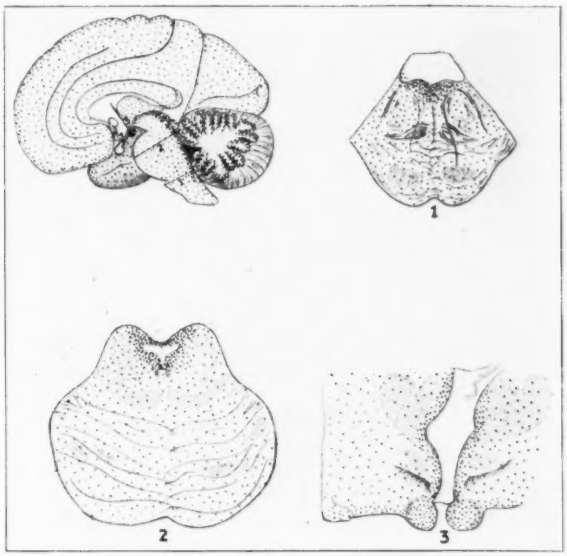

Fig. 4 (case 2).—Appearance of the brain stem.

severe along the floor of the ventricles and the base of the brain and optic chiasm. Concerning the localization of disturbances, the same may be said as for case 1. The pupillary changes may have been correlated with lesions in the floor of the aqueduct and the surface and base of the midbrain, in accordance with Ingvar's[14] findings.

CASE 3.—*Clinical History.*—A man, a chauffeur, aged 37, was brought to the hospital on a charge of disorderly conduct on June 9, 1931. He had been drinking heavily for two years and steadily for six or eight weeks, but had stopped eight days before. After that he had had hallucinations of people walking about his room, had misidentified relatives and had been confused. On admission he was dull, confused, resistive, unsteady and tremulous. His speech was thick and incoherent. The pupils reacted sluggishly to light. The tongue was beefy and

14. Ingvar, Sven: On the Pathogenesis of the Argyll Robertson Phenomena, Bull. Johns Hopkins Hosp. **43**:363, 1928.

tremulous. He was clumsy, ataxic and tremulous in all movements. The tendon reflexes were present and equal, and the Babinski reaction was negative. Examination of the heart, lungs and abdomen gave negative results. The Wassermann reaction of the blood and spinal fluid was negative. The colloidal gold curve with the spinal fluid was 12210000; the total protein was 6.25.

Fig. 5 (case 2).—A section from the anterior end of the fourth ventricle with the anterior medullary velum at the top and the fasciculus longitudinalis medialis in each lower corner. Numerous hemorrhages are seen in both masses of periventricular gray. The region involved is that in which the ocular muscular nuclei at higher levels appear. The white masses of the fasciculus longitudinalis medialis are free except for one hemorrhage on the left side. A mild grade of subependymal gliosis is also seen. Mallory's connective tissue stain; reduced from × 55.

On June 12, he was dull and tended to perseverate his first response to any command. Speech was slowed, slurred and thick. He had difficulty in swallowing. He was unable to walk without support and showed extrapyramidal rigidity. Nystagmus was noted, but cooperation was poor for ocular movements. The pupillary reactions were sluggish. On June 13, he was dull, not talking but fum-

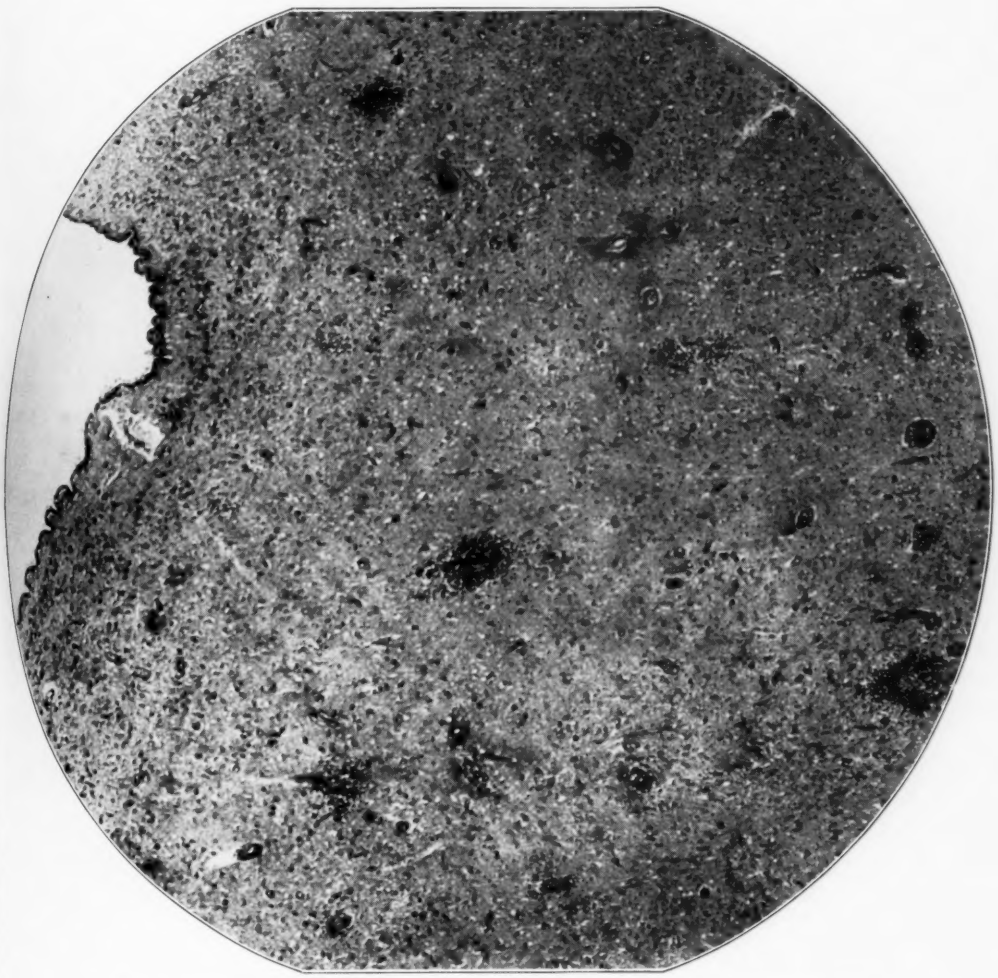

Fig. 6 (case 2).—A section from the wall of the third ventricle showing many hemorrhages invading the region of the anterior thalamic nucleus. The blood vessels show proliferative changes. The ependymitis is marked. The irregular hummocky outline is due to proliferative changes while the underlying wall of gliosis is invasive. Mallory's connective tissue stain; reduced from × 55.

bling with the bed clothes in a delirious way. He was incontinent. The pupils were dilated, unequal, and reacted poorly to light. There were partial bilateral ptosis, bilateral abducens weakness and failure of convergence, associated with

staring and some tendency for the eyes to wander upward. He would turn his head rather than his eyes when he wished to look to either side. There were changing rigidities and convergence tendencies in the arms, with an increased defense reaction to pain.

On June 15, the expression was blank; the patient made rotary movements of the head and held his hands in the air as though whirling a string; there were awkward pseudo-athetoid movements of the hands. He looked straight ahead with only slight movements of the eyes to the right, showing an external ophthalmoplegia. Pupillary reactions were prompt. There were resistance and rigidity of

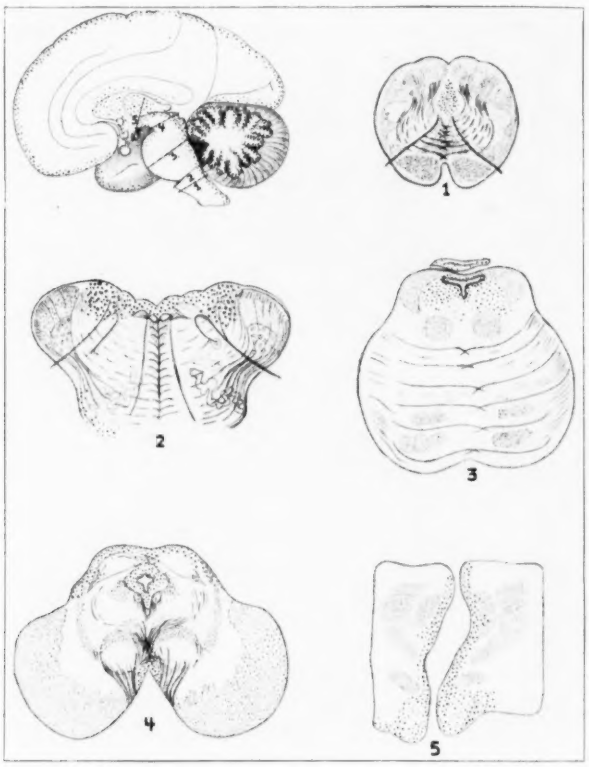

Fig. 7 (case 3).—Appearance of the brain stem.

the neck, and rigidities of the arms that increased with tensions, especially in the arm-shoulder muscle group, and the same was true of the thigh group. The tendon reflexes were brisk in the upper extremities and normal in the lower; there was a normal plantar reaction. There was a positive support reaction in the lower extremities. On June 18, he was more apathetic, showed a complete ophthalmoplegia and a grasping reflex, and was beginning to show bulbar and respiratory difficulties. He died on June 19. Autopsy, performed on the next day, showed anthracosis of the lungs, congestion of the stomach, fatty infiltration of the liver, hypertrophy of the bladder, hypertrophy of the prostate and congestion and edema of the brain.

Histopathologic Studies.—The brain stem (fig. 7) and selected areas from the cerebrum and cerebellum were studied. At the lower end of the medulla there was gliosis about the central canal. Higher in the medulla there was a marked ependymitis of the floor of the fourth ventricle, and there were small hemorrhages in the nuclei of the eighth, ninth and tenth nerves (fig. 8). There was also an

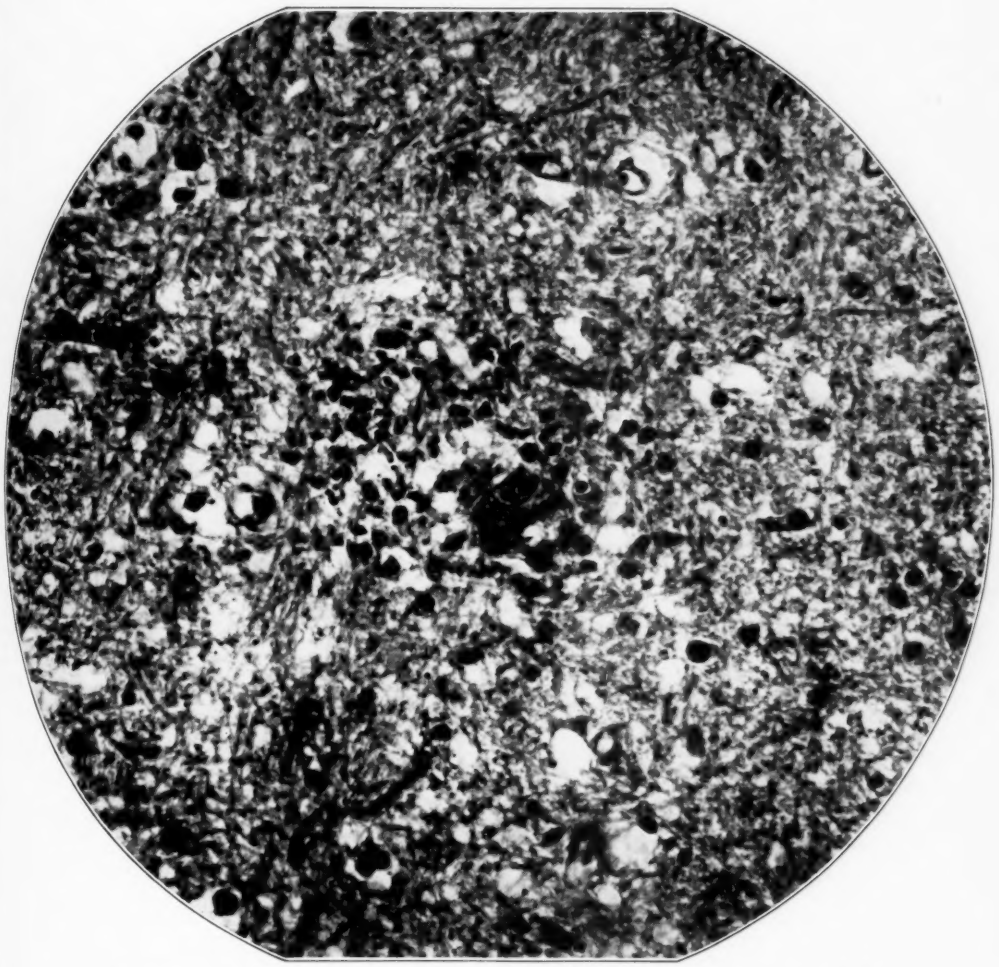

Fig. 8 (case 3).—High power magnification of a section of the center of the motor nucleus of the vagus nerve in the floor of the fourth ventricle, showing a small perivascular hemorrhage by diapedesis with an intact blood vessel in the center. Mallory connective tissue stain; reduced from × 500.

increase in capillaries in the same region, together with a fresh glial reaction, with fibrous and cytoplastic forms and some disintegration of the tissues. At the level of the pons, including the overlying velum and some folia of the cerebellum, there was a severe ependymitis which encroached on the lumen of the aqueduct of Sylvius,

and there were numerous severe hemorrhages about the vessels in the ventricular gray masses extending down into the reticular formation and involving the fasciculus longitudinalis posterior and the locus caeruleus and deeper tissues (fig. 9). There was also a considerable glial reaction here. The folia of the cerebellum showed an increase in the vascular bed and small hemorrhages. At the level of

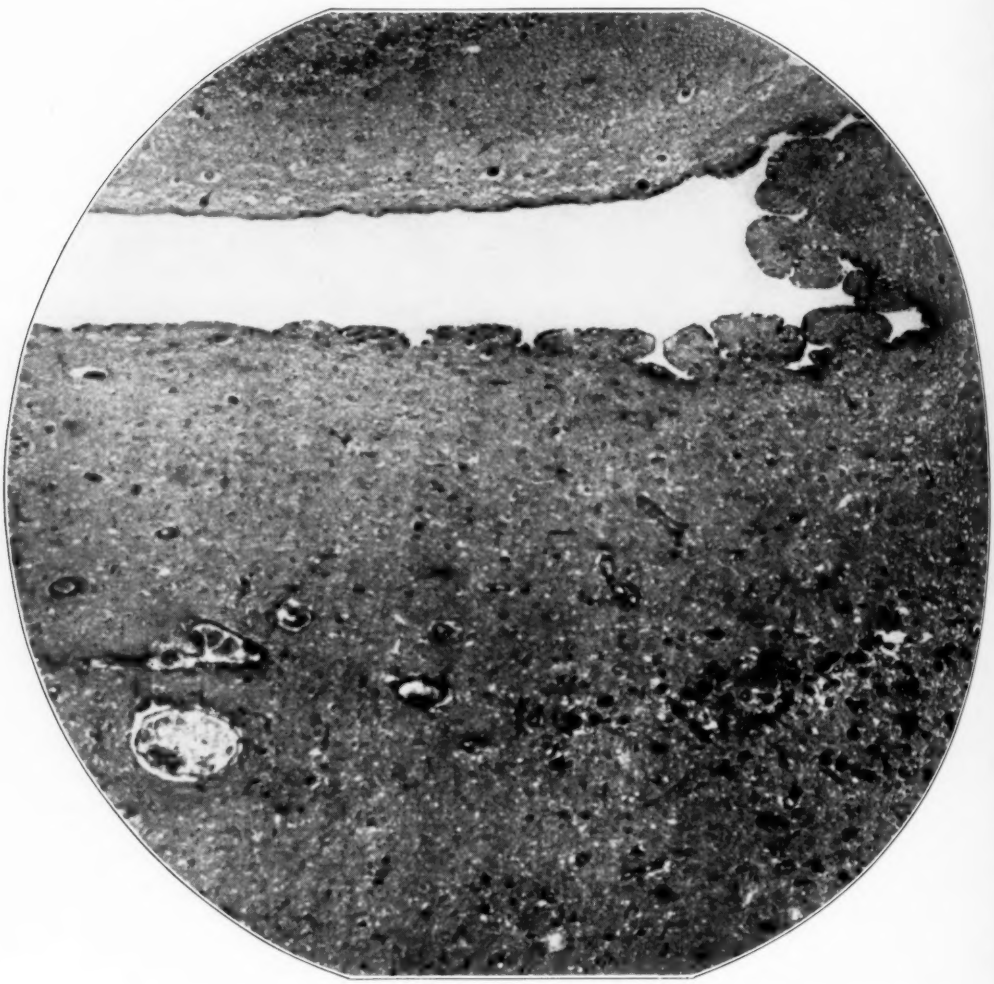

Fig. 9 (case 3).—A section of the anterior end of the fourth ventricle with an overlying lobule of the lingula of the cerebellum and the underlying locus caeruleus. Proliferative changes in the ependyma are seen with cauliflower-like hummocks which tend to narrow down the lumen of the ventricle. These are most marked in the corners and recesses. Proliferative changes in many of the smaller vessels are seen, both in the cerebellum and in the subventricular gray areas, especially in the floor of the ventricle, where there are also perivascular hemorrhages, budding of the capillaries and astrocytic glioses about the larger vessels. Mallory connective tissue stain; reduced from × 68.

the midbrain that included the anterior quadrigeminate body, the red nucleus and the nucleus of the fourth nerve, the ependymal and vascular reaction was not so severe, although there was some invasive gliosis which involved the nucleus of the fourth nerve. There was some marginal reaction of the glia and blood vessels on the upper surface of the quadrigeminate body with a tendency toward invasion of the lesion along the blood vessels that entered the tissues from the pia, especially near the midline. The red nucleus was free. At the level of the third ventricle and the mammillary bodies there was a severe ependymal reaction involving all parts of the wall of the third ventricle. The mammillary bodies showed the most severe lesion and were almost entirely replaced by a vascular organization, hemorrhages and fresh glial reaction, including both fibrous and cytoplastic forms of glia cells. Halfway up the wall of the ventricle was an area that showed an unusually severe reaction (fig. 10). Here the astrocytic form predominated. The lesion here invaded the lower border of the thalamus rather deeply. There was also a region in the anterior thalamic nucleus of fresh cytoplastic gliosis and softening. In the anterior part of the caudate nucleus, bordering on the anterior horn of the lateral ventricle, there were areas of marked congestion, with small and large hemorrhages about the vessels associated with a surrounding gliosis. The cerebellum showed some small hemorrhages about the tiny vessels that invaded the cortex from the pia. In the cerebral cortex were numerous small areas of budding capillaries, with hemorrhages and a fresh glial reaction, mostly of the cytoplastic type. These all lay just below the pia, involving only the first and second layers of the cortex.

Summary and Comment.—There was a severe ependymal reaction of the whole ventricular system with an irregular marginal involvement of the surface of the cerebrum, cerebellum and brain stem, such as the upper surface of the quadrigeminate bodies. Besides this, the ventricular gray masses were involved, especially in the medullary nuclei and the level of the pons, but less in the midbrain, and again severely in the third ventricle, including the mammillary bodies and the central parts of the thalamic and caudate nuclei. The lesions were characteristically an ependymitis and marginal gliosis, with an underlying increase in the vascular bed, congestion, hemorrhages and an extensive invasive and reactive gliosis.

The outstanding clinical features were: (1) clouding of consciousness, with delirious features; (2) serious troubles with speech and with the impulses; (3) increased reaction to pain; (4) severe ophthalmoplegia; (5) changing rigidities; (6) a grasping reflex; (7) pseudo-athetoid movements; (8) a positive support reaction in the lower extremities, and (9) asynergia of the trunk.

This case adds further evidence of the same kind as in our previous consideration of the localization of disturbances. The support reaction and grasping reflex were probably in connection with the lesions in the same apparatus that produced the changing rigidities. The lesion in the folia of the cerebellum and the roof of the fourth ventricle accounted for the asynergia.

CASE 4.—*Clinical History.*—A man, aged 35, was admitted on May 15, 1931, on voluntary application and stated that he had been drinking heavily. He said: "I was here a few months ago. This time I drank for six nights. I began vomiting last night." He complained of gastro-enteritis. He knew the date. His pupils reacted to light. On May 23, he presented deep clouding of consciousness and did not talk. He had a rigid face, a tendency toward sucking and a grasping reflex. The pupils were narrow, but still reacted to light. He could not move the eyes to either side or upward completely, so that he usually looked downward; he could

not converge. There was stiffness all over the body, which was like a resistance. All movements were awkward, and he remained in queer athetoid postures. Tendon and abdominal reflexes were present and there was a normal plantar reflex. There was an exaggerated reaction to pain all over the body, with especially strong retractions of the legs when the plantar reflexes were examined. The skin on the

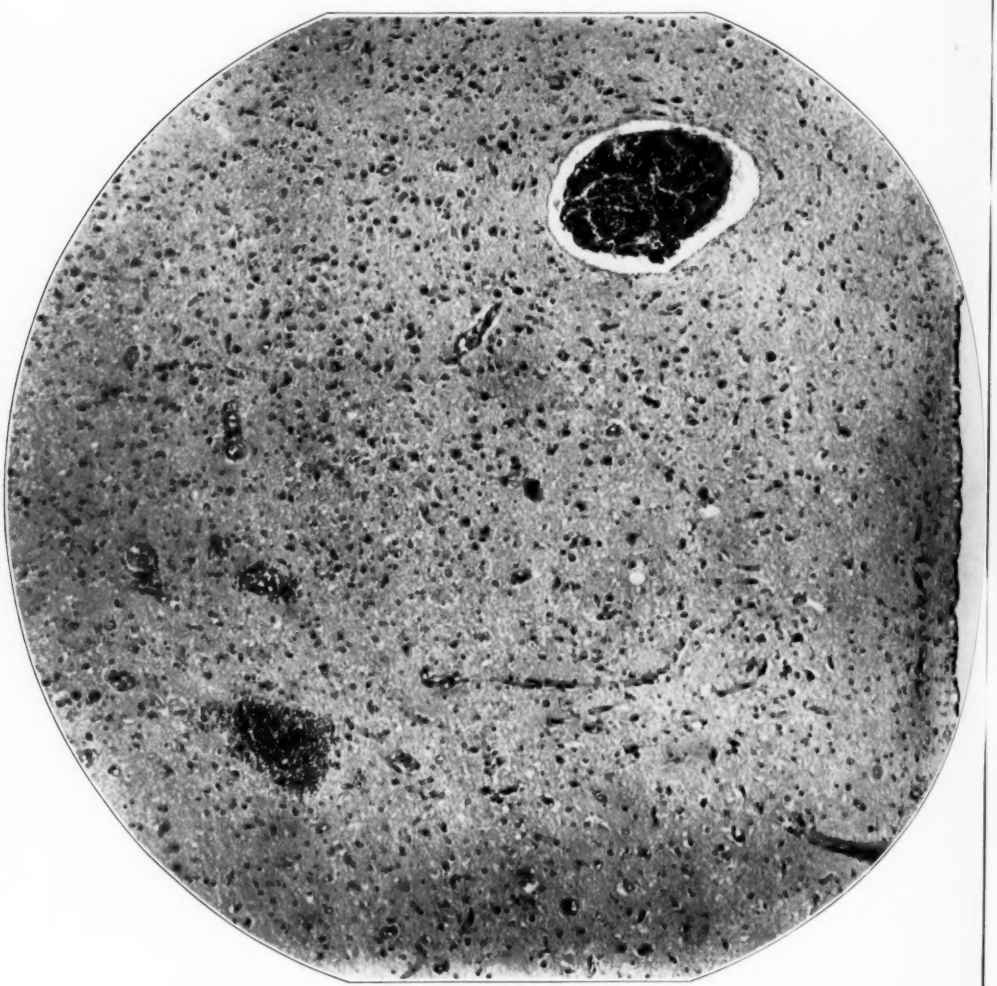

Fig. 10 (case 3).—A section from the wall of the third ventricle showing the marginal ependymitis represented by the large vesicular ependymal cells and the underlying wall of invasive glioses. Hemorrhages are seen in the region of the thalamic nucleus. There are also proliferative changes in the smaller vessels and a perivascular space about the large vessel. There is some diffuse gliosis. Mallory connective tissue stain; reduced from × 85.

extensor surfaces of the hands showed a desquamating pellagroid lesion. The internal organs were normal. The Wassermann reaction with blood and spinal

fluid was negative. In the right eyeground, below the disk was a large fresh hemorrhage. The patient was restless at night. On May 25 his speech was slurred and bulbar in type. He sometimes looked to the right side with both eyes. He was a little more active. Caloric stimulation of the ears did not produce any reaction. Touching of the lips provoked immediate pouting. There was rigidity in both legs, with some degree of catalepsy. The left great toe was held in the Babinski position. Tensions in the arms and legs were associated with a support reaction. Throughout, he spoke only occasional words. On May 28, he said: "There is only one toilet. See what they are doing." On June 8, he could get on his feet, but showed retropulsion. He was anxious to obey commands, but tended to hold postures, and showed a resistance against passive movements. He usually looked straight ahead, though the eyes sometimes showed spontaneous movements to either side, associated with a horizontal nystagmus. On this date, convergence was possible, but upward movements of the eyes were still impaired. Pupillary reactions were prompt. When shown a picture of a girl, he said, "It is a monkey," thus showing difficulty in the apperception of pictures. His speech was slurred. He said: "There is nothing the matter with me; I came in this morning. I am in the observation ward. This is January, 1928."

By June 12, the cutaneous disturbances had cleared up. He now talked continuously. He still showed stiffness and pseudo-athetoid movements in the hands. There was a strong flexor tendency in both elbows. There were only partial difficulties in the ocular movements. He was transferred to the Manhattan State Hospital on June 17, 1931. Following is a report received from there: "Incontinent of urine; unable to feed himself; speech practically unintelligible; markedly deteriorated; psychomotor activity increased; restless; dysarthria of speech. There was very little emotional display. At times it seemed as if he might be reacting to auditory hallucinations. Tremor of facial muscles. Positive Gordon Holmes reaction. Atrophy of the limbs. Nystagmus present. Speech thick and scanning. Wassermann reaction of the blood negative; Kahn test negative; colloidal gold curve 0000000000. Patient showed marked asynergia of extremities, head and trunk. There was marked ataxia in the finger-to-nose test, a constant wagging tremor of the head and occasionally of the left arm and leg. Pupils were unequal and sluggish. There was a primary optic atrophy. Speech was dysarthric and slurred. Deep reflexes were all active and brisk. Plantar response difficult to elicit because of hyperkinesia. On September 3, he showed emotional instability and was tearful; there were marked coarse movements of the hands and legs. The pupils were equal and reacted well to light. On October 5, he was quiet, kept shaking his head from side to side, and was constantly coughing and masturbating; the sensorium was defective. On October 9, he died. The diagnosis was alcoholic psychosis, Korsakoff, delirious type. Cause of death, chronic alcoholism; hemorrhagic alcoholic encephalitis; contributing cause of death, bronchopneumonia."

Summary and Comment.—Clinically there were: (1) clouding of consciousness, with delirious features; (2) grasping and sucking reflexes; (3) complete ophthalmoplegia, except for upward movements; (4) absence of vestibular reactions to irrigation of the ears; (5) bulbar speech; (6) changing rigidities; (7) athetoid movements; (8) support reaction; (9) convergence reactions in the arms; (10) increased reaction to pain; (11) pseudo-pellagrous reactions in the skin; (12) retinal hemorrhages. It is of interest that at the state hospital atrophy of the retinal disks and pupillary disturbances developed. There were apparently also additional cerebellar signs. In this case the encephalopathy led to death after six months. Otherwise the case is typical. It is of especial interest that fresh hemor-

rhages were observed in the retina; they are probably comparable to the hemorrhages seen microscopically in the central nervous system in the other cases studied.

Case 5.—*Clinical History.*—A man, aged 42, who was brought to the hospital on May 28, 1931, had always been well until the preceding winter when he had pneumonia. After that he felt weak and started to drink. On admission, he was tall, emaciated, shaky and tremulous, and showed a pellagroid rash on both hands. The pupils were unequal; the left reacted to light better than the right. He showed tensions all over the body which were similar to resistances. The Wassermann reaction of the blood and spinal fluid was negative. On June 3, he said, "I'm all right—all right." He could not name objects. A few days later he said, "This is some place in Harlem." He picked at imaginary objects and was confused. It was impossible to get more than a few words from him. There was no true aphasia, but difficulty in getting out the words and a seeming lack of impulse for speech were noted. After June 8, he did not talk at all. After considerable desquamation, the pseudo-pellagrous lesions on the hands were replaced by an atrophic skin. There continued to be irregular tensions in all extremities that looked like resistances. The hands assumed awkward athetoid positions. When the arms were passively extended they diverged at the shoulders and converged at the elbows. He had a marked sucking reflex and a marked grasping reflex, especially in the right hand. The hands were held completely stiff when passive movements were made with the arms. Stiffness in the legs was even more marked. There was an increased reaction to pain shown by a marked retraction of the legs when the plantar reflexes were examined. The facial expression was rigid. The tendon reflexes of the arms were normal, but the achilles reflexes were not elicited, possibly owing to the tensions. He was always grasping in a semidelirious way. The ocular movements, pupillary reactions and eyegrounds were normal. In the next few days he became more restless, and the grasping tendencies increased. The hands remained in the air in queer stiff athetoid postures. The mouth was held half open, with the head retracted and the eyes wide open. He sometimes acted as though he had hallucinations. He died on June 14, 1931.

Summary and Comment.—The symptomatology in this case showed: (1) clouding of consciousness, with delirious features; (2) sucking and grasping reflexes; (3) difficulty in bringing out words; (4) changing rigidities; (5) athetoid movements; (6) increased reaction to pain, and (7) pseudo-pellagrous changes in the skin, with subsequent atrophy. The case is remarkable because there were no signs referable to the eyes.

Case 6.—*Clinical History.*—A woman, aged 31, who was admitted to the hospital on June 28, 1931, was violent and excited. She said that she had been drinking for about a week. She said: "I have heard people talking. I can't hear what they say. I saw my husband this morning. I have had some trouble, but I can't tell you because it doesn't concern you." She had visual hallucinations and was disoriented for time and place. The eyelids were slightly ptotic. The pupillary reactions were prompt. She made very quick, jerky movements, especially in the shoulders, but there were no muscle spasms. She had grasping tendencies, especially with the right hand. Tensions similar to voluntary tensions sometimes occurred and made her rigid. Sometimes she displayed something similar to cataleptic tendencies in the legs. Pointing positions with both index fingers were often seen. Achilles and patellar tendon reflexes were absent, as were the abdominal reflexes. There was soreness of the muscles of the calves of the legs, with an increased reaction to pain. On July 2, the pupils were stiff and all ocular movements were poor; she was able only to make a few nystagmoid

upward movements. There was a slight rigidity of the neck, which was changeable. There were rhythmic movements of both hands. The Wassermann reaction of the blood and spinal fluid was negative, as were also other spinal fluid tests. The patient died on July 5, 1931.

Summary and Comment.—This case showed: (1) clouding of consciousness, with delirious features; (2) ophthalmoplegia; (3) grasping tendences; (4) changing rigidities; (5) tendencies to rhythmic movements; (6) quick jerky movements, and (7) an increased reaction to pain. The case is significant because of the quick jerky movements, which occurred in a picture otherwise similar to that in the preceding cases. Later, we shall describe cases in which these movements were the dominating feature.

CASE 7.—*Clinical History.*—A man, aged 46, was admitted to the hospital on March 13, 1931, with a history of severe alcoholism. He was rambling, incoherent, confused and disoriented, and said: "My name is Ryan (not true). I have been drinking at the hotel. I am just beginning to get overcome. It is overcoming me. I don't think I am much of anything. I am at Center Street." It was difficult to get an answer from him; he gave his name incorrectly, and was slow in obeying commands. The facial expression was rigid, but the pupils reacted promptly. He recognized simple pictures but not more complicated pictures. All tendon reflexes were present and normal. The plantar reflex was negative, but the Hoffmann reaction was positive on the left and there was a transient ankle clonus on both sides. There was some tenderness in the muscles of the calves of the legs. When rhythmic movements were started, he tended to continue them. When he stood up, he swayed and fell backward. There were many changing rigidities in the limbs. Sometimes it was almost impossible to make any passive movements. He had a tendency toward paradoxical contractures, and sometimes assumed athetoid postures. He grasped in a delirious way. He did not move when placed in bed, and lay immobile without covering himself unless directed to do so. He showed support reaction in both legs, but sometimes the stiffness in the knees would not disappear when the toes were bent. There was a general tendency toward stiffness in both legs. The extensor rigidity diminished in the next fortnight, but did not disappear entirely. He confabulated, saying, "I was here yesterday. I was watching the dead men. They were all over the bridge. I was on a rampage drinking whisky for two months. It is a wonder I didn't get killed. I'm not safe here either. They are likely to come for me any minute. Those men are in the gang." The patient died on March 25. No postmortem examination was made.

Summary and Comment.—This case showed: (1) clouding of consciousness, with delirious features; (2) a Korsakoff picture; (3) changing rigidities; (4) athetoid postures; (5) a support reaction; (6) asynergia between the trunk and legs; (7) a positive Hoffmann sign and ankle clonus, and (8) neuritic tenderness. In this case there were signs of a lesion of the pyramidal tract. Toward the end of the observation period the mental picture approached a Korsakoff psychosis. Neuritic signs were also present.

CASE 8.—*Clinical History.*—A man, aged 48, was transferred from another hospital on June 5, 1931, with a diagnosis of dementia paralytica. The Wassermann reaction of the blood was negative. Nothing was learned of the previous history. He was friendly but disoriented, and said: "You are an inceder—that's an investigator—I am inceptor. She is helper for in the incinerator. I am 38; my father is 52; my mother 42." Sometimes he showed ability to carry out complicated commands, but readily became confused. Sometimes he stammered badly. The pupils were small and practically fixed to light. He could not converge the

eyes. The tendon reflexes were normal all over the body. There was no plantar reflex. He fell back when put on his feet and showed many changing rigidities in the limbs. On June 11, he was friendly, stammering at the beginning of words but talking fluently. He said he was at Fordham hospital and was sure that he had seen the examiner on the day before, which was not true. He was suggestible to confabulation. When asked the difference between a child and a midget, he said, "There is something to it." When asked the difference between a bush and a tree, he said, "One grows and the other one ceased growing." A few minutes later he had forgotten both questions. Pupillary reactions were prompt and the ocular movements normal. The facial expression was rigid and there were slight changing rigidities in the arms. There was some tendency to grasp, but there was no groping. The outstreched arms showed a tendency to convergence at the shoulder and flexion at the elbows, the right more so than the left, and also changing rigidities of an extrapyramidal type in the legs. There were both positive and negative support reactions in the legs. There was a marked asynergia between the trunk and the limbs, and the trunk was drawn backward. Patellar and achilles tendon reflexes were lively. There was an extreme defense reaction against pain when the plantar reflexes were tested, and, in general, pain produced an exaggerated reaction.

On June 13, the patient was transferred to the Manhattan State Hospital. They gave the following report: "When admitted he was feeble, deteriorated and completely disoriented. His pupils were sluggish to light, but reacted fairly well in accommodation. Knee and ankle jerks were present and active; speech was slurred. The blood Wassermann reaction was negative with alcoholic antigen; two plus with cholesterolized antigen; Kahn test, two plus; spinal fluid, negative to all antigens; colloidal gold curve 11122210000. On June 21, he was in poor condition and incontinent. His answers to questions were incoherent and irrelevant; he reacted to auditory hallucinations; he was disoriented, and remote and recent memory were poor. On July 8, the knee jerks were exaggerated, the pupils fixed and irregular in outline and the speech thick. He showed a marked mental deterioration; he was unclean in habits, and required spoon feeding. He died on July 28, 1931."

Summary and Comment.—This case showed: (1) a psychic picture akin to a Korsakoff psychosis; (2) disturbances in speech akin to stammering; (3) a variable pupillary reaction to light; (4) difficulties in ocular convergence; (5) asynergia; (6) changing rigidities; (7) a marked support reaction; (8) a grasping reflex, and (9) increased reaction to pain. The ocular signs were relatively insignificant.

Comment.—The most constant feature in the clinical picture is the clouding of consciousness, which may be of different depths. Usually, in the course of the illness the clouding increases as the general condition becomes worse, or the clouding subsides as the patient improves. With the clouding of consciousness there always occur delirious features, together with grasping and groping. With the mental confusion there are also disorientation and difficulty in the perception of objects. The patients cannot differentiate well pictures shown to them, especially more complicated ones. There are also difficulties in the integration of the various impressions in perception. With the lessening in the disturbance in consciousness, the mental picture tends to become more

like that of a Korsakoff psychosis. However, a typical Korsakoff psychosis did not occur in any of our cases. Probably clouding of consciousness and delirium are two different psychopathologic entities. It is known that clouding of consciousness, as such, is due chiefly to a retardation in all psychic processes, including those dealing with perception. The essence of confusion is a failure to come to a full perception. Objects are perceived only in parts and incompletely, or when the whole is perceived, it is not possible to differentiate it into its parts. The different parts of the perception are mixed together, and this is true of mental images as well as of the perception of objects. The internal and external worlds are not well separated from each other. However, the mechanism of confusion is not identical with the mechanism of hallucination, although in the presence of confusion hallucinations occur more readily. In the cases described, the clouding of consciousness played a much greater part than in the usual cases of mental confusion, such as occurs in the toxic psychosis that Meynert called amentia.[15] On the other hand, the inability to grasp a complicated perception is less pronounced in our cases than in postinfectious confusional cases. The picture has some similarity to delirium tremens, in which a moderate degree of confusion is associated with a strong tendency toward hallucinations. In our cases, the hallucinations do not play such an important part. To summarize, we may say that the mental picture is dominated by clouding of consciousness, in which the difficulties in perception play the most important part, while difficulties in the integration of perception play a less important part, and hallucinations the least of all.

In a short differentiation between Korsakoff psychosis and delirium, it may be said that in Korsakoff psychosis the difficulties in the integration of material in the past, or memory, are more pronounced than in immediate perception. There is no clouding of consciousness. Instead of hallucinations, one sometimes finds an active tendency toward confabulation, which essentially means a mistake in the differentiation synthesis of the memory material. In cases 4, 7 and 8 there are features akin to the Korsakoff psychosis, but the outstanding feature is the clouding of consciousness, which is sometimes combined with a tendency toward rhythmic movements, such as may be initiated by passively starting the movement of a limb in a rhythmic way, the patient tending to continue it. This phenomenon was especially noted in cases 1 and 6.

Other phenomena, which are probably in close connection with the clouding of consciousness, are grasping, groping and the sucking reflex. Grasping and groping are phenomena of considerable interest. They

15. Hartmann, H., and Schilder, P.: Zur Klinik und Psychologie der Amentia, Ztschr. f. d. ges. Neurol. u. Psychiat. **92**:273, 1924. Mayer-Gross: Selbstschilderungen der Verwirrtheit. Die Oneiroide Erlebnisform, Berlin, Julius Springer, 1924.

are known in delirium tremens in connection with hallucinations, when the patient grasps at imaginary or real objects. Under careful observation it may sometimes be seen that this grasping is autonomous and not based on either perceptions or hallucinations. But still the grasping and groping lie on a psychic level. Pointing also plays on important part on a psychic level. In an early observation, one of us (Dr. Schilder) described the case of a person who first hallucinated objects, then pointed at them and finally tried to catch them. Genetically, pointing is a mitigated grasping. One points when one cannot touch the object, and touches when one cannot grasp the object. In its essence, every kind of pointing is a grasping. Besides the psychic level of pointing and grasping, there is a physiologic level for the same phenomenon. Schuster and Pineas [16] have studied this phenomenon carefully, and in this country Freeman and Crosby [17] and Davis and Currier [18] have published articles on the subject. We are not interested here in the question as to whether this phenomenon arises from lesions of the striopallidum or frontal lobe; it is probable that lesions in either area may produce it. It appears that both physiologic and psychologic levels may be integrated together. The grasping in delirium tremens may have a purely neurologic basis, which initiates or modifies the psychic attitude. Betlheim [19] has shown this interaction of the two levels in an illuminative case. The physiologic basis of pointing has been emphasized by Goldstein and Boernstein.[20] Gruenbaum [21] has lately described the pointing reflex, and maintains that it belongs to the same group of phenomena as grasping and groping. Groping is in some way between pointing and grasping. One of our cases (case 6) showed the tendency to assume pointing positions with the index finger. It seems possible that these primitive tendencies come out when there is clouding of consciousness. In some way the clearness of consciousness seems to have an inhibitive effect. But besides this general influence there appear to be special apparatus, destruction of which brings grasping and groping to the surface. The same is true of the sucking reflex, first described by Wagner-Jauregg in advanced dementia paralytica.

16. Schuster, P.: Ztschr. f. d. ges. Neurol. u. Psychiat. **83**:586, 1923. Schuster, P., and Pineas: Weitere Beobachtungen über Zwangsgreifen und Nachgreifen, Deutsche Ztschr. f. Nervenh. **91**:16, 1926.

17. Freeman, W., and Crosby, P. T.: Reflex Grasping and Groping, J. A. M. A. **93**:7 (July 6) 1929.

18. Davis, D. B., and Currier, F. P.: Forced Grasping and Groping, Arch. Neurol. & Psychiat. **26**:600 (Sept.) 1931.

19. Betlheim: Zur Frage des zwangsmässigen Greifens bei organischen Hirnerkrankungen, Monatschr. f. Neurol. u. Psychiat. **57**:141, 1924.

20. Goldstein and Boernstein: Ueber sich in pseudospontanen Bewegungen aüssernden Spasmen, Deutsche Ztschr. f. Nervenh. **84**:234, 1925.

21. Gruenbaum: The Pointing Position of the Hand as a Pathological and Primitive Reflex, Brain **53**:267, 1930.

Betlheim [22] has shown that it may also occur when there is a lesion of the gyrus supramarginalis, associated with an apraxia of the face.

Thus, it appears that grasping, groping and pointing and sucking have a neurologic apparatus at various levels. The findings of Gamper [23] show that there must be at least medullar and midbrain centers for these activities. Striopallidal influences are also acting, and there are probably cortical centers in the frontal lobe as well as in the supramarginal region. These are in addition to general cortical influences which may or may not be working on the level of psychophysiologic integration.

As our anatomic findings show, there are widespread lesions of the central nervous system, and it is difficult to say which particular lesions are at the base of the clouding in consciousness. The most constant area of lesion is in connection with the ventricular gray matter, and it seems probable that these lesions play a part in the genesis of the clouding. It is also probable that the effect of such a lesion in the ventricular gray matter would not be so far reaching if there were not also disturbances in cortical function. At any rate, cerebral function as a whole is impaired, not only by the toxic and anatomic disturbances, but also by functional influences arising from the injured vegetative centers. Kleist [24] has often emphasized that there is a chain of centers of consciousness which extends from the medulla oblongata to the posterior wall of the third ventricle. It is more than probable, according to von Economo [25] and Weissman and Schilder,[26] that also the more proximal parts of the ventricular gray areas, especially the base of the third ventricle and the subthalamic region, have something to do with the regulation of consciousness.

The clouding of consciousness and its anatomic and functional basis may be partly responsible for the grasping, groping and pointing on the psychophysiologic level of integration. But in case 1, especially, we also observed lesions in the striopallidum. Little is known about which particular brain stem center has to do with these activities. Since there are lesions in the brain stem, we have to reckon with the possibility that the apparatus for grasping, groping and sucking is impaired in various points of its organization.

The next group of phenomena to be considered are the changing rigidities, athetoid movements and asynergiae between the limbs and

22. Betlheim: Säuglingsreflex bei Apraxie, Jahrb. f. Psychiat. u. Neurol. **43**: 226, 1924.

23. Gamper, E.: Arrhinencephalie, Ztschr. f. d. ges. Neurol. u. Psychiat. **104**: 49, 1926.

24. Kleist: Ueber episodische Daemmerzustände, Leipzig, Thiele, 1926.

25. von Economo: Schlaftheorie, Ergebn. d. Physiol. **1**:28, 1929.

26. Weissman, M., and Schilder, P.: Amente Psychose bei Hypophysengangtumor, Ztschr. f. d. ges. Neurol. u. Psychiat. **110**:767, 1927.

trunk. The rigidities are of a special type and to our knowledge have not been described before. It is sometimes difficult to differentiate them from an active resistance, and they are changeable in appearance, but certainly are not due to a psychic influence alone, although psychic influences may play an important part. Active movements are also awkward and stiff and lead to queer postures in which the patient sometimes appears almost cataleptic. The athetoid movements are probably closely related to these changing rigidities. There is usually not a definite tendency to flexion or extension. It is true that the legs are mostly extended and there is a greater tendency to flexion in the arms, especially at the elbows. The flexor tendency at the elbows definitely links these rigidities with the convergence phenomena described by one of us (Dr. Schilder [11]) in alcoholic patients and with the paralysis agitans picture. The athetoid movements of the fingers sometimes show some relation to pointing and grasping. Another important feature in these rigidities is that they show a definite relation to the support reaction. When, for instance, the toes are bent upward, the legs become completely stiff and cannot be bent at the knee. Flexing the toes makes the legs immediately flexible, and the stiffness disappears. Apparently this is a particular type of tension reflex, although the localization of its center is not possible at present. The most probable hypothesis is an association with the tonus centers near Deiters' nucleus and the substantia reticularis. In this particular group of cases the subthalamic region and the striopallidum are also involved, as well as Deiters' nucleus and its neighborhood. Certainly the latter are important centers of tone, but in our group of cases, in which the tensions are so prominent, the lesions are more widespread. Kleist [27] and his pupil Strauss [28] have pointed to the instinctive resistance (*triebhaftes Widerstreben*) which they associate with thalamic lesions. The phenomenon was observed in ten cases of arteriosclerotic softening. But in all of their cases the putamen was involved as well as the thalamus, and in some cases other parts of the brain were involved as well. Kleist emphasized the similarity of this phenomenon to an automatic negativism minus a general negativistic psychic attitude. The phenomenon of negativism he called counterfixation (*Gegenhalten*). It is a resistance to change in posture brought about by a muscular tension, which increases with the effort of the examiner. From an introspective point of view, this counterfixation is an instinctive resistance and is connected with a particular feeling reaction. Kleist pointed out that the same phenomenon is seen in focal lesions of the brain, as well as in psychosis.

27. Kleist: Bewegungsstörung und Bewegungsleistungen der Stammganglien des Gehirns, Naturwissenschaften **15**:973, 1927; Gegenhalten, motorischer Negativismus, Zwangsgreifen und Thalamus opticus, Monatschr. f. Neurol. u. Psychiat. **65**:317, 1927.

28. Strauss: Stutzreaktion und Gegenhalten, Nervenarzt **4**:399, 1931.

But in focal brain lesions the instinctive resistance is chiefly reactive, while in psychosis it is more spontaneous. He was of the opinion that such a counterfixation is also directed against gravity. Mayer and Reisch [29] have observed similar phenomena which they call preparedness to resistance (*Widerstandsbereitschaft*). With hemiplegia, the phenomenon occurs on the nonparalyzed side. Kleist and Mayer and Reisch drew attention to the common coincidence of this phenomenon with grasping and groping, and claimed that the primary center for its integration lies in the medulla, but Mayer and Reisch also believed that it may be released as well by lesions in other parts, such as the thalamus. Strauss pointed to the similarity between the support reaction and the negativistic resistance, and showed that it is characteristic of the support reaction that it occurs only when the hand or foot is passively hyperextended or dorsiflexed, whereas the tension rigidity disappears when the hand or foot is brought in the opposite relation to the arm or leg, but he inconsistently stated that the support reaction occurs only when the patient is unable voluntarily to relax the muscles. The support reaction and instinctive resistance are certainly not identical, as Mayer and Reisch claimed. In our cases the support reaction was present without the resistance. When we try to correlate the findings in our cases with the observations of Kleist and Mayer and Reisch we find two outstanding points: (1) The psychic factor in resistance is much more prominent in our cases than in the purely neurologic conditions described by the other authors; (2) the rigidities are very changeable and spontaneous; these changing rigidities could be elicited when the patient acted against resistance. Our patients also showed spontaneous athetoid movements. Our findings were in many ways similar to conditions that are present in catatonic states. This problem will be more fully discussed in connection with the next group of cases. It is difficult to know whether all of these phenomena are release phenomena or irritative responses arising directly from the injured areas which are presumably responsible for them. It should also be noted that it is possible that the clouding of consciousness and the underlying physiologic factors may increase the tendency to these tensions, as we have often observed that they increase the tendency toward instinctive resistance. The clouding of consciousness acts partially as a psychic factor. The outward world becomes more threatening and more dangerous, and there follows a greater resistance against any interference from the outside. There are also certain physiologic factors which underly the phenomena of clouding and which may be responsible for the muscular tensions, but even so the central changes in the tonic apparatus are certainly more significant.

29. Mayer and Reisch: Ueber die Widerstandsbereitschaft des Bewegungsapparates, Verhandl. d. Gesellsch. deutsch. Nervenaerzte **17**:258, 1928.

Of course we do not think that these tensions are found only in encephalopathia alcoholica. We have observed two arteriosclerotic cases in which similar tensions were present. We present a brief history in one case.

A man, aged 60, showed marked arteriosclerosis and gave a negative history for alcoholism. When admitted, on May 25, 1931, he had a rigid facial expression, with the mouth held half open and the lower part of the face flaccid. The hands were held in a rigid position and there was a strong resistance against opening them. There were negativistic tensions in the arms and rigidities in the hands, partly following the support reaction. There was rigidity of the neck, which was partially voluntary. The pupillary reactions were prompt. The patient walked with small steps and remained in awkward positions. He did not obey orders or imitate postures. He had a grasping tendency and a sucking tendency. He showed a strong defense reaction to pain. On May 26, he lay in bed with the eyes closed and assumed queer postures. He showed changing rigidities in all limbs. Sometimes he suddenly changed position, for example, raising the left arm with pointed fingers, and remained in this position stiffly for a while. He did not talk. On May 28, he showed rigidities, partly of a voluntary type, and sometimes assumed a pointing position with the fingers. There was a strong grasping tendency. The fingers remained cataleptic in positions given to them, but especially if placed in a pointing position. He was transferred to the Manhattan State Hospital on June 1, 1931. The following report was received from there: "He was restless, especially at night, insisting on getting out of bed and walking around. He took only milk and was entirely incontinent. He lay in bed in the day time in a stuporous state, and reacted to stimuli by crying. If the arms were raised from the bed he held them there for a long time. There were no spontaneous movements, except to resist when stuck with a pin. He kept his eyes shut and his mouth open. His facial expression was vacant. He resisted an attempt to open his eyes. He occasionally carried out simple commands, but most of the time he paid no heed. At times he uttered a few words, usually in an unintelligible manner. He never emerged from the stuporous state in which he entered the hospital, but became more and more comatose, and died on June 31, 1931. Diagnosis: Psychosis with cerebral arteriosclerosis. Cause of death, cerebral hemorrhage.

Another case was in an arteriosclerotic person with epileptic attacks. In another case, a catatonic picture followed an injury of the head without a fracture of the skull. In this case the psychic influence on the rigidity was especially strong. Kauders (unpublished report) demonstrated to one of us (Dr. Schilder), long ago, a similar case of doubtful origin, but certainly not alcoholic.

It is remarkable that the clouding of consciousness does not diminish the reaction to pain, but that, on the contrary, in all of our cases there was an exaggerated response to pain with an especially vivid defense reaction. This comes out especially well in the response to the stimuli for plantar reflexes, which call forth an exaggerated flexion of the whole leg. There is probably an impairment of the inhibitory mechanism for the reaction to pain, just as there is an inhibition in the primitive reactions for sucking and grasping, but this phenomenon is probably related also to the increased tendency toward muscular resistance.

Mayer and Reisch observed hyperalgesia on the side homolateral to a capsular lesion among the cases reported by them, and Schmidt [30] observed that in about half the cases of hemiplegia there is an increase in the sensitivity of the skin and of the deeper tissues. Babinski and Jarkowski [31] found hyperalgesia on the side of the paresis as well as on the other side.

Asynergia, or the dissociation between the movements of the legs and the trunk, is one of the common symptoms in our cases. Asynergia is well known as a cerebellar sign. In our cases coming to autopsy there were lesions on the margin of the cortex, in the folia overlying the ventricles and in the roof of the fourth ventricle. Later we shall discuss cases in which the cerebellar symptoms are in the foreground, and show that asynergia is associated with these lesions, especially of the dentate nucleus. It is also possible that the clinical appearance of the dissociation between the trunk and limbs is partially due to the rigidities. At least, the stiffness makes the falling of these patients more impressive. Thus, it is possible that the rigidities cover a part of the cerebellar symptomatology. Typical intentional tremors were not observed in any of our cases.

The support reaction was first described by Rademaker [32] in animals in which the cerebellum had been removed. Later, Schwab [33] found it in human beings, and showed that it occurred with lesions of the frontal and temporal lobes. Its actual localization is not known. Our material suggests some relationship to the tensions, and perhaps even that such tensions are necessary for the support reaction. Both positive and negative support reactions were observed. When the legs of the patient are in a state of tension and the toes are pushed down, the tension relaxes. If there would be only a resistance in the common sense, one would expect an increase in tensions under these conditions. The support reactions are therefore more than an expression of the tensions. Whether the cerebellar lesions are sufficient to explain their occurrence is doubtful. They seem to be related to lesions in the tonus apparatus, as we have already discussed.

Many of our cases showed marked disturbances in speech. There were bulbar dysarthrias, difficulties in bringing out words, lack of impulses and troubles akin to stammering. The speech troubles observed here are most like those seen in diseases of the extrapyramidal

30. Schmidt, A.: Homolateral Hyperaesthesie bei Hemiplegia, Arch. f. Psychiat. **219**:501, 1918.

31. Babinski and Jarkowski: De la surreflectivité hyperalgésique, Rev. neurol. **37**:433, 1921.

32. Rademaker: Statik und Motilitätsstörungen kleinhirnloser Tiere, Verhandl. d. Gesellsch. deutsch. Nervenarzt **16**:144, 1926.

33. Schwab: Ueber Stützreaktionen beim Menschen, Ztschr. f. d. ges. Neurol. u. Psychiat. **108**:585, 1927.

tract. Disturbances in muscle tone are partly responsible and it is possible that lesions in the nucleus of the tenth and twelfth nerves play a part.

From time to time we have observed other signs of widespread lesions in the central nervous system. One case showed a positive Hoffmann sign and ankle clonus. In other cases more definite signs of a lesion of the pyramidal tract may be found. Various neuritic signs may also be present. Optic atrophy developed in one patient who lived a relatively long time. Histopathologic changes were noted in the optic nerve in two of the cases coming to autopsy. Oculomotor signs are, of course, due to lesions in the nuclei of the oculomotor nerves, which are located in a vulnerable position in the gray areas about the aqueduct, and also in the fasciculus longitudinalis posterior. It is remarkable that in case 1, paresis of the right internal rectus alone was present, and that signs of ocular paralysis were absent in case 5 in spite of the otherwise evident severity of the lesion. In case 8 there were difficulties only in converging the eyes. Other cases usually showed a divergent palsy. In two cases, upward movements only were preserved. Fixation of the pupils to light and other serious disturbances in the pupillary reactions were observed. This subject will be discussed again later.

In cases of chronic alcoholism one is not dealing with a disease of the central nervous system alone. The patients are always extremely emaciated. Sweating is common. Elevation of the temperature without a septic process is observed again and again. Pseudo-pellagrous changes in the skin of the hand are seen. The whole digestive tract is diseased, and the patient has a coated tongue, digestive disturbances and diarrhea. Retinal hemorrhages are noted. It may be supposed that there is a general disease of the organism which expresses itself all over the body, or even that the changes elsewhere are primary and the changes in the brain secondary. It is possible that there is an intermediate cause related to the liver and digestive tract which is significant in the genesis of the cerebral lesions. Since we have not as yet made special investigations in this direction, we shall not discuss this hypothesis at present. Gamper [1] called attention to the fact that the lesions involve the centers for the vegetative functions of the whole organism. All of the patients in this group died. In some cases death occurred suddenly and after a short interval, while other patients lived for six months, in which case there might be improvement at first. In the grouping of these cases we were guided by the clinical picture and learned only subsequently that the pathologic findings further justified the classification. The clinical picture is therefore highly characteristic, as is also the pathologic picture. The lesion is widespread, especially along the ventricular surfaces, but also on the external surfaces, and hemorrhages play an important part in contrast to other groups in this series, as will be seen shortly. The term polioencephalitis haemorrhagica superior, as

Bonnhoeffer and Schroeder pointed out, is not justifiable. There is no inflammatory process and, as we shall show, hemorrhages do not always occur. However, for this group the term encephalopathia or polioencephalopathia haemorrhagica would be justified.

II. CASES IN WHICH THE CEREBELLAR SYMPTOMATOLOGY WAS PROMINENT

CASE 9.—*Clinical History.*—A man, aged 39, was admitted to the hospital on June 22, 1931, with a history of heavy drinking. At the time he showed poor pupillary reactions and impairment of ocular movements so that when he tried to look upward or sideways the eyes moved only downward; convergence was also unsatisfactory. The eyegrounds were normal. The right arm showed an outward deviation, which increased when the head was turned to the left. The hands tended to supinate spontaneously, and turning the head to the left increased this also. Furthermore, when the arms were extended in front and the head was turned to the left, the right arm moved inward and upward while the left arm moved outward, with a tendency to flexion at the elbow. There was a marked cerebellar tremor of the right arm, but almost none of the left. The tendon reflexes were present in the arms, while the patellar and achilles reflexes were absent. There was soreness of the muscles of the legs and of the arms. The Babinski reaction was negative. There was weakness of the legs, especially in the upper part, and on the left this weakness was mixed with a cerebellar tremor. The patient displayed great difficulty in sitting up, owing to the weakness of the trunk muscles and an asynergia between the trunk and the limbs. Turning to the left in the turning chair produced none of the usual reactions; turning to the right produced only an inadequate nystagmus and subjective dizziness. Pseudo-pellagrous changes were present on both hands. He showed an hallucinatory psychic picture. He did not know how long he had been in the hospital and thought that he was in the Jefferson market. He said: "Five of us escaped. Were you up to see my sister? You are Mr. Barnes, aren't you? I saw you in the Bronx. It is May, 1931 or 1932. Yesterday I was a strong man pushing big heavy trunks and now I am so weak." He made jokes when pictures of children were shown to him, and said, "It is cows jumping over fleas." There was no clouding of consciousness until just before death on June 29. There was no postmortem examination.

Summary and Comment.—This case showed: (1) no clouding of consciousness in the beginning, but hallucinations and confabulations, while clouding of consciousness gradually developed toward the end; (2) severe ophthalmoplegia, including convergence difficulties; (3) absence of the normal vestibular reaction to turning; (4) marked cerebellar signs, including lateral deviation of the right arm; (5) tendency to flexion at the elbow, but no other tensions; (6) peripheral neuritis, with weakness in the trunk and upper part of the legs; (7) pseudo-pellagrous changes in the skin of the hands. This case differs from those of the previous group in that the tensions do not play an important part. Only flexion in the elbow was present, which, according to one of us (Dr. Schilder), is a reliable sign of extrapyramidal tract disease. The cerebellar signs that were present were intentional tremor, deviation of the right arm and a paradoxical reaction of the outstretched arm or a deviation to the left side when the head was turned to the right. Schilder and Hoff [34] have shown that this paradoxical reaction is a cerebellar

34. Schilder, P., and Hoff, H.: Die Lagereflexe der Menschen, Vienna, Julius Springer, 1927.

sign. The absence of the usual reaction to turning on the turning chair is probably due to a lesion in Deiters' nucleus and its neighborhood. We have found similar impairment in this reaction in other cases as well, but not all of our patients have been examined by the Bárány methods. The following case shows an interesting dissociation in the Bárány reaction. The case is important since it offers some hints for the localization of these reactions.

Case 10.—*Clinical History.*—A man, aged 51, was admitted on Dec. 12, 1929, after having had trouble with walking, and pains in the legs for five or six months. He was in an intoxicated state, tremulous and picking at the bed clothes as though he were grasping small objects. He said: "I want to get the color of that shirt. There is brown paint in my sleeve." On December 17, he was delirious, picking at things and refusing to eat. He had difficulty in recognizing pictures, usually noticing only parts of them. He said: "It is in the monthly bulletin. It gives you information. If you are sick, they send you a doctor after three days. I am here in my father's house. I only came in here today. I was in St. George. There is the recording angel." When he tried to stand, he fell to the left and backward. He could not look to the left or right, but only upward or downward; convergence was preserved. During the following days convergence contractures developed. Both pupils reacted poorly to light. Movements of the jaw were extremely awkward. Irrigation of the ears did not produce a nystagmus on either side, but did produce the usual deviations in the arms and trunk. When the arms were outstretched they diverged strongly at the shoulder, with flexion at the elbow. There was a spontaneous turning of the trunk to the left. When the head was turned to the left, with the arms outstretched, the left arm went higher. He also had a strong pronation tendency, a slight intention tremor, a bradyteleocinesia, and a slight adiadokokinesis, more marked on the left side. Tendon reflexes in the arms were normal. Marked awkwardness was displayed in the hand grip. In the legs there was a slight intention tremor, especially on the left. Patellar reflexes were weak, but the other reflexes in the legs were normal. There were no signs of neuritis. He died with signs of insufficiency of the heart on December 20. The Wassermann reaction of the blood and spinal fluid was negative, and the spinal fluid was otherwise normal. Postmortem examination showed bronchopneumonia.

Neuropathologic Studies.—The brain stem (fig. 11) and selected areas of the cerebral and cerebellar cortex were examined. Sections from the lower end of the medulla, just below the opening of the ventricle, showed ependymitis of the central canal, with reduplication of the ependymal cells, and an increase in the surrounding fibrous glia cells. There was also a thickening of the blood vessel walls in the adjacent areas, with widening of the perivascular spaces. There were thickening of the pial and arachnoid membranes and some marginal gliosis. A section through the medulla at the level of the nuclei of the eighth to twelfth nerves (fig. 12) showed ependymitis of the floor of the fourth ventricle, with an underlying layer of a fibrous and collagenous mass. The vessels of this area were thickened and showed enlarged perivascular spaces. Many were also surrounded by hemorrhages. The lesion was most severe just below the lateral recess, adjacent to the restiform body, and thus involved mainly the nuclei of the eighth and tenth nerves. The lesion also involved the nucleus of the twelfth nerve, but the fasciculus longitudinalis posterior was intact. A section through the pons and nuclei of the sixth and seventh nerves showed an ependymal reaction, which was even more marked than at the previous level, and fragmentation and vacuolation of the superficial layers. There was also some underlying vascular reaction, though it was less marked, and the nucleus of the sixth nerve was apparently intact; there was,

however, considerable invasion of the nuclear mass of the eighth nerve. A section of the lateral recess of the fourth ventricle including the cerebellar vermis, the dentate nucleus and the pontile peduncle, showed the usual ependymitis with an underlying fibrous tangle and vacuolation and fragmentation, especially at the angle of the recess. A deeper vascular lesion involved the dentate nucleus, with several small hemorrhages and vascular organization. At the level of the pons and the decussation of the fourth nerve there was a more severe lesion than at any of the lower levels. It was similar, but more intensive and more invasive. There was some pial thickening with subpial gliosis all about the brain stem. It was more

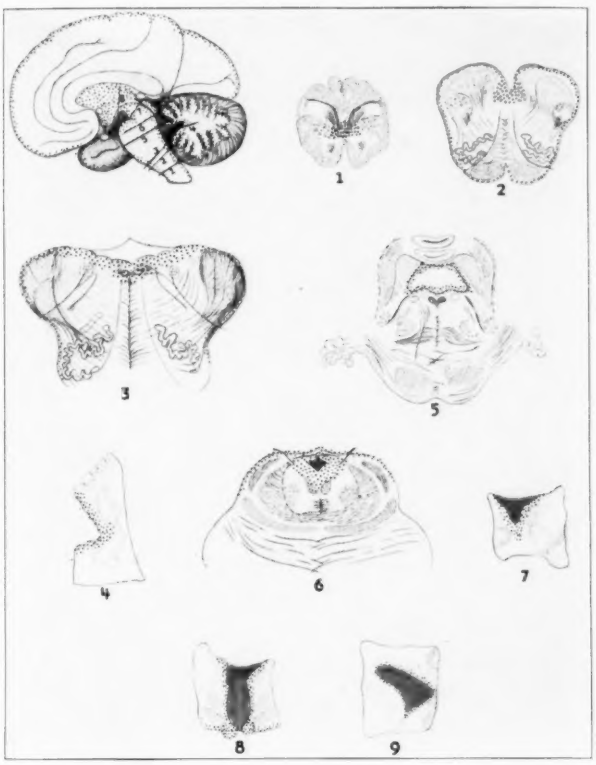

Fig. 11 (case 10).—Appearance of the brain stem.

marked on the dorsal surface. Most of the ventricular gray mass, including the nuclei of the fourth nerve, was involved in the hemorrhagic and vascular reaction. The Weigert stain showed that the fasciculus longitudinalis posterior was free from either primary lesion or secondary degeneration. The Marchi stain did not reveal any evidence of secondary degeneration of any of the myelinated tracts. A section through the third ventricle and the mammillary bodies (fig. 13) showed a severe lesion involving all the wall of the ventricle, the mammillary bodies, the commissure between them and much of the nuclear masses near the ependyma, especially in one area halfway up the wall on either side. The lesion was essentially an ependymitis, with underlying vascular organization and hemorrhage.

There were some fatty changes in the nerve cells, with granular phagocytes about the vessels. About the anterior horn of the right lateral ventricle there was a moderate degree of ependymitis, which was most severe on the lower surface. The cerebellar hemispheres showed some small hemorrhages in the interlobular vessels. In the cerebral cortex there were some fatty degeneration of the larger nerve cells

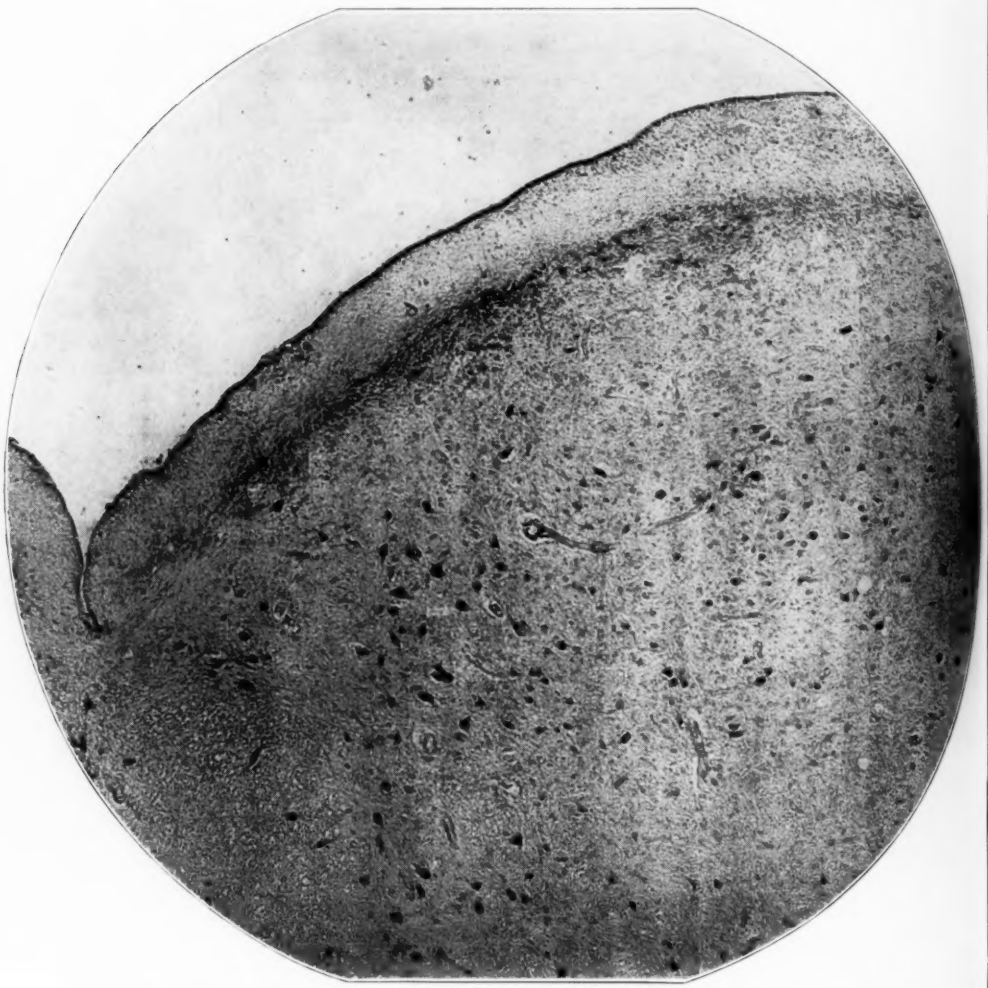

Fig. 12 (case 10).—A section through the floor of the fourth ventricle with the central raphe on the left with the nucleus of the twelfth nerve just to the right of it, the nucleus of the tenth nerve in the center and parts of the nuclei of the eighth nerve on the extreme right. The marked ependymal reaction is seen by a thickening of from one-half to three-fourths inch in the picture. The wall of gliosis beneath the surface probably represents the normal site of the ependyma. The additional tissue is a loose meshwork of glia fibers filled with a mucilaginous or amyloid substance. The ependymal surface is irregular. The underlying wall of glia cells shows invasive tendencies. In the nuclear centers is seen congestion with budding and proliferative changes in the vessels. Nissl stain; reduced from × 68.

and some fatty deposits in the phagocytes about the blood vessels, while in some areas at the base of the interlobular crevices, where the pia dipped in, there were budding of capillaries and an increase in the fibrous and cytoplastic glia cells. In all areas, there were a considerable number of corpora amylacea.

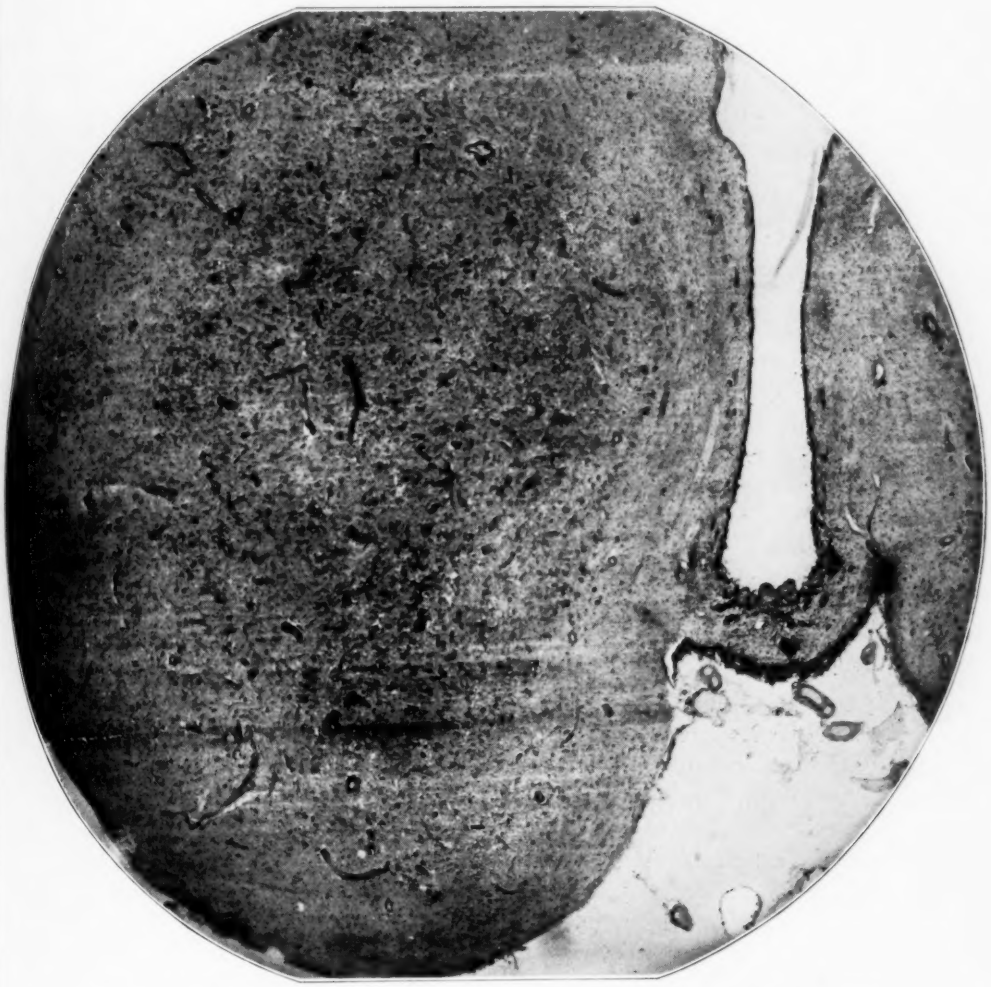

Fig. 13 (case 10).—A section showing the whole of one mammillary body with the lumen of the third ventricle on the right. There is a very extensive vascular organization of the whole of the mammillary body while the ependyma of the wall of the third ventricle shows proliferative and invasive reactions. Eosin-methylene blue (metheylthionine chloride U. S. P.) stain; reduced from × 20.

Summary and Comment.—There were ependymitis and subependymal vascularization in the ventricular gray matter for the whole length of the ventricular system, which were more severe in the floor of the ventricles but present also

in the roof, as in the quadrigeminate bodies, the dentate nucleus, the vermis of the cerebellum and the lateral thalamic nuclei. It was most marked in the fourth ventricle along the recess beneath the restiform body, thus involving especially the nucleus of the eighth nerve; also in the floor of the aqueduct, involving the nuclei of the oculomotor nerves, and in the floor of the third ventricle, involving the mammillary bodies. The surface of the cerebrum and cerebellum showed less involvement, with some fatty changes in the nerve cells. The margin of the brain stem showed some gliosis.

Clinically, this case showed: (1) a delirious picture with moderate clouding of consciousness; (2) falling to the left and backward, with spontaneous turning of the trunk to the left; (3) strong divergence of the arms; (4) bradyteleocinesia and adiadokokinesis; (5) intention tremor; (6) pronation tendencies; (7) no tensions, except the convergence reaction at the elbows; (8) conjugate palsies of sideward movements of the eyes, with preservation of convergence and gradually developing convergence contracture of the ocular muscles; (9) inadequate pupillary reaction to light, and (10) failure of nystagmus on caloric stimulation of the ears, with the usual deviations of the arms and trunk.

Some of the neurologic problems in this case deserve discussion. There was, for instance, a double paralysis of the conjugate movements of the eyes. Oppenheim [4] has connected this phenomenon with a lesion of the fasciculus longitudinalis posterior on both sides. Although in our case there was no evidence that this tract was injured directly, we may suppose a disturbance in its function, since the areas about it and nuclear masses associated with it were injured. Clinical examination showed that we were not dealing with a weakness of the muscles as such, since the patient was able to use the internal rectus muscles for convergence. Gradually, a convergence contracture developed. According to Brunner,[35] the absence of nystagmus from caloric stimulation of the ears is due also to a lesion of the fasciculus longitudinalis posterior. According to him, this experimental nystagmus is absent when the nuclei of the ocular muscles are destroyed, when both fasciculi longitudinales posteriores are destroyed, or when one of these tracts and the arcuate fibers of the opposite tract are injured. It is interesting that in this case the deviation of the arms and trunk was present following caloric stimulation of the vestibular nerve, while nystagmus was not. This shows that the pathway for the reaction of the trunk and arms to vestibular stimulation is different from the pathways for nystagmus. Deiters' nucleus showed considerable injury in this case, but was not entirely destroyed. Perhaps its partial preservation accounts for the preservation of the trunk and arm movements, or perhaps the pathways for the body movements are not dependent on Deiters' nucleus.

It is easy to connect the histopathologic findings with the clinical cerebellar signs. The dentate nucleus, as well as other parts of the roof of the fourth ventricle, including the center of the cerebellum and its

35. Brunner: Ergebnisse der Funktionsprüfung des Ohres, Zentralbl. f. d. ges. Neurol. (pt. 1) **37**:145, 1926; ibid. (pt. 2) **44**:1, 1927.

vermis, were involved in the lesion and apparently more so in this case than in the cases of the previous group. Also, in this case the thalamus, subthalamic region and putamen were less extensively involved. The reactive glioses and proliferative changes in the vessels were more marked than the hemorrhagic responses. It appears that in this case we were dealing with a process that in some way was a little different in localization, less widespread and less severe than in the other cases. This difference may account for the absence of tensions and rigidities, and also for the fact that the clouding of consciousness was less severe.

The case offers also some interesting data relative to the problem of pupillary disturbances in alcoholic patients. There was a severe impairment of the pupillary reaction to light, whereas the reaction in accommodation was preserved. We may therefore say that the patient displayed Argyll Robertson pupils. It has already been mentioned that pupillary changes in cases of encephalopathia alcoholica are not common; even incomplete Argyll Robertson pupils are rare. The genesis of the pupillary disturbances in these cases is from lesions in the nuclei of the intrinsic ocular muscles or in the pathway that connects the optic nerve with them. The diffuse nature of the lesion in our cases forbids a definite localization, but it may be recalled that Ingvar [14] showed by means of comparative studies that the fibers concerned in the Argyll Robertson phenomenon pass over the surface and base of the midbrain to the nuclei of the ocular muscles and are thus most likely to be involved in submeningeal or marginal lesions such as are seen here. The lesions in the floor of the aqueduct offer a further explanation for the pupillary changes in alcoholic patients. In our experience, pupillary disturbances are common in acute alcoholism, although these changes are not far-going or long-lasting and, according to Schilder and Parker,[36] resemble the pupillary disturbances observed in catatonic patients; however, it would appear that in acute alcoholism the alcohol attacks similar parts of the brain.

III. CASES RESEMBLING ACUTE CATATONIA

CASE 11.—*Clinical History.*—A man, aged 31, was admitted on Nov. 11, 1929, with a history of having been a heavy drinker for many years. When admitted, he was delirious, groping and pulling, and smoking imaginary cigarets. On November 15, he was much confused and made queer grimaces. Speech was halting. He was very restless. He walked with a broad base, and was stiff and shaky and fell backward. There was a tendency for the limbs to become suddenly stiff, and all movements were occasionally interrupted by myoclonic jerks. The arms were flexed. All other neurologic findings were normal. The Wassermann reaction was negative. The skin was dry. He said: "Yes, yesterday you showed me a magazine. It was gruesome. It had a girl's name. (Where are you?)

36. Schilder, P., and Parker, S.: Pupillary Disturbances in Schizophrenic Negroes, Arch. Neurol. & Psychiat. **25**:838 (April) 1931.

I trust to fate where I am. In the bone—in the bone—jackass. I watch the sky. (Don't you see any difference since you are here?) It is lighter and bluer. (Where are you?) Oh, near Germany, France, Germany—from 1917 to 1940. (Where are you now?) I was since then without consciousness but I know that every minute I was inside and outside hospitals. What uniforms do the people wear: moustaches, revolvers or what?" He named simple objects, and grasped them firmly. If his arms were rhythmically moved, he continued the movement alone. On November 18, he was very aggressive. He was jerky in all movements and tossed about in bed. He was very noisy. He knew where he was, but his thought processes were much disconnected. His emotional reactions changed suddenly. On November 19, he jumped up and down in bed and rolled from one side to the other. He pushed his head rhythmically from left to right and backward and forward, or held his head in queer postures, staring at the ceiling. Speech was inarticulate. He said: "You are stuck now. The idea is the first. You went through everything." His temperature rose to 38.5 C. (101.3 F.), and on November 20 it rose to 40 C. (104 F.). He was excited and restless at this time, opening and closing his mouth rhythmically and showing rhythmic movements of the lips. He snapped at objects and continued grasping, but there were no tremors. There were changing rigidities in the legs, which sometimes changed into rhythmic movements of flexion and extension. He died on this day. There was no autopsy.

Summary and Comment.—Clinically, this case showed: (1) far-going dissociation in thinking and also, probably, disturbance of consciousness; (2) a tendency toward rhythmic movements; (3) motor restlessness and myoclonic movements; (4) a grasping reflex; (5) asynergia, and (6) changing rigidities. The psychic changes were predominant. The extent of the dissociation in thinking was more outstanding than the clouding of consciousness. In the neurologic picture, the absence of oculomotor signs is remarkable. The case differs from those in the group with changing rigidities in the presence of myoclonic movements.

Case 12.—*Clinical History.*—A man, aged 42, who was admitted on Oct. 13, 1929, had been a heavy drinker throughout his life, but lately had drunk more than usual; he had not been able to work for three months. Two weeks before admission, he heard voices and said that he wished to die. On admission, he was sullen and disoriented for place and time; he soon stopped talking, and shouted out suddenly as though he heard voices. His facial expression was stiff, tense and staring. The pupils reacted less well to light than in accommodation. The eyegrounds were normal. He often remained in cataleptic positions. He was continuously grasping, but not in a delirious way. The fingers were often held in an outspread position, and the little finger was often hyperextended at the proximal joint. When walking, the trunk was drawn backward. He showed a swaying, cerebellar ataxia. The abdominal and achilles reflexes were not obtained, but the patellar reflexes were present. The Wassermann reaction was negative with the blood and the spinal fluid. The colloidal gold curve was normal; there was no increase of globulin or cells in the spinal fluid. He said: "This is a hospital. Governor Whalen has killed all the Jews. Darling, darling, come! The doctor has sent me here. I drink hard liquor, gin. I am God." He suddenly sat up and became restless. (What do the voices say?) "Many things. The truth lies." (Who are you?) "God." On October 16 his speech was disconnected. He threw himself out of bed. He said, "Are you a citizen?" He hid under the sheets and apparently had hallucinations. He often failed to answer questions. Often, tensions would appear suddenly all over the body. On October 18, he said, "They shot me just now," and made wild defensive movements. On October 20, while walking, he

suddenly stiffened and fell back. There were athetoid movements in the hands, and the small finger was abducted. He had sudden outbursts; once he said, "Go away." On October 24, he assumed queer postures, grasped the arm of the examiner and clung to him. He showed no negativism. On October 26, there was a pill-rolling tremor of the right hand, with variable rigidities in all limbs. He shouted: "There—there they come—here—here—there!" He blew out his lips. He died on October 29.

Histopathologic Studies.—A less exhaustive study was made of the brain in this case because the specimen was accidentally destroyed before the study was completed. A section through the pons and the posterior quadrigeminate body showed an ependymal reaction, with narrowing of the lumen of the aqueduct of Sylvius and many pockets of ependymal cells (fig. 14). Beneath this was a heavy wall of reactive gliosis. There were also congestion and vascular organization of the upper layers of the quadrigeminate bodies and a slight reaction of this sort in the ventricular gray matter surrounding the aqueduct. A section through the anterior thalamus and the lateral ventricle showed a moderate ependymal reaction about the lateral ventricle. The cerebral cortex showed a marked pallor and distortion of the nerve cells, with a definite loss of Nissl pigment. This was more severe than in any of the other brains studied. Sections of the cerebellum showed no lesion.

Summary and Comment.—It may be assumed that the same lesion was present throughout the ependyma and subjacent gray centers along the ventricles in this case as in the others, but that it was limited more to a glial ependymal reaction, and there was less extensive vascular disturbance.

Clinically, this case showed: (1) clouding of consciousness with extensive dissociation in thinking; (2) a tendency toward rhythmic movements; (3) athetoid and cataleptic postures; (4) changing rigidities, restlessness and sudden movements, and (5) a grasping tendency. This case is almost identical with the previous one. The psychosis was dominated by extensive dissociation in thinking. There is a marked similarity of these cases to acute catatonic pictures; the motor signs, however, are of a more massive and neurologic type. The rigidities link this group definitely with the previous one. The absence of oculomotor signs corresponds with the fact that there are fewer histopathologic changes in the ventricular gray matter.

Case 13.—*Clinical History.*—A colored man, aged 45, who was brought from home by his wife on Oct. 10, 1931, had been drinking heavily for many years, had been unemployed for two years and for two weeks had been overtalkative, obscene, restless and belligerent and was losing weight. On a previous admission, in 1928, he had recovered in five days from an acute alcoholic confusional state. At that time he had been restless, picking at the bed clothes, tremulous, requiring restraint, noisy, yelling for a knife, euphoric and disoriented. On the present admission, he was euphoric, disoriented, and had confabulatory hallucinations. He was emaciated and decrepit. The pupils were moderately dilated and practically fixed to light; ocular convergence was poor. There was a fine tremor of the hands. Within a few days he became worse. He was resistive, restless and tremulous, and showed an occupational delirium. He gave irrelevant, incoherent replies and acted as if he were responding to auditory and, perhaps, visual hallucinations. He appeared anxious, kept his fists clenched and usually maintained queer postures. Physical and neurologic examination at that time revealed: normal fundi, practically fixed pupils, normal ocular movements, tremors of the facial muscles, a beefy, excoriated, tremulous tongue, increased and changing rigidities in the limbs, especially

the legs, active deep reflexes and absent abdominal reflexes. The Wassermann reaction of the blood was four plus. Examination of the spinal fluid on two occasions showed a negative Wassermann reaction, no cells, no globulin and a colloidal gold curve of 0001210000. At this time he said: "If you hurt me, God damn you, I will kill you! All my bones are broken." (Why don't you sit straight?) "That

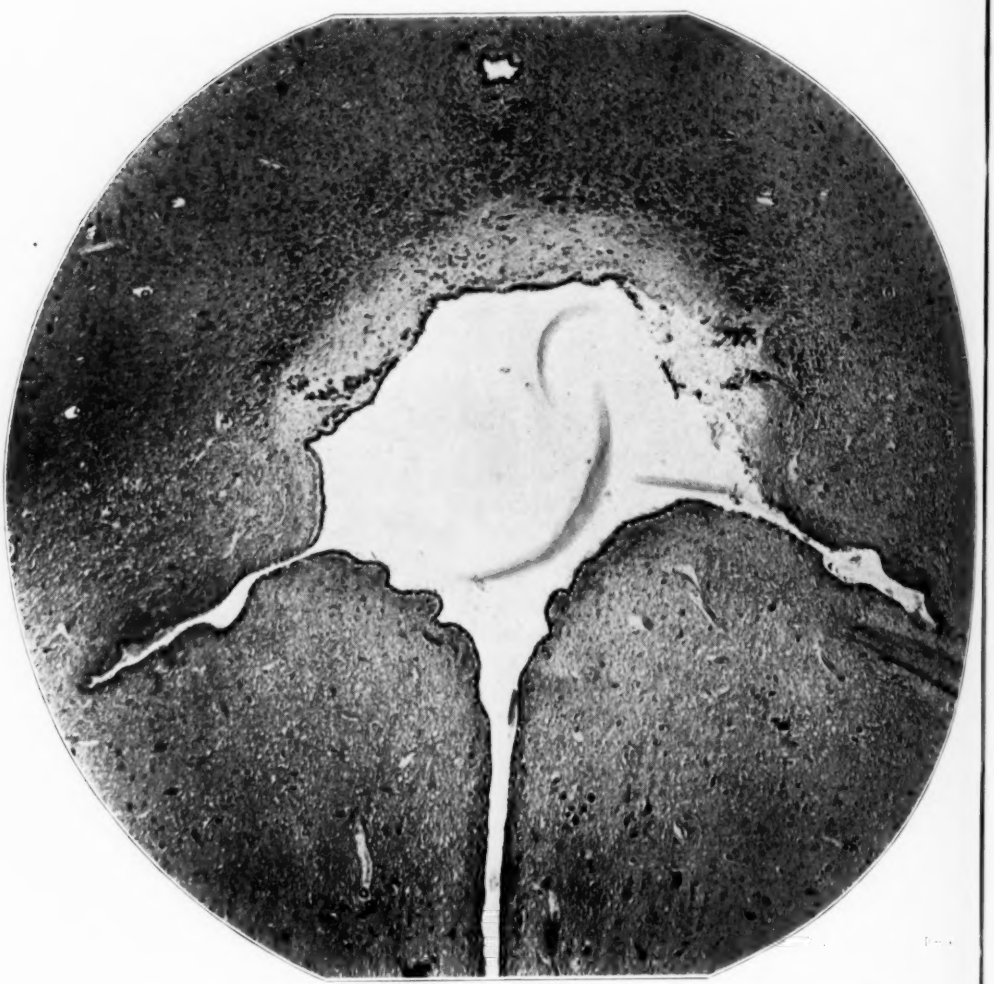

Fig. 14 (case 12).—A section of the aqueduct of Sylvius showing a pronounced ependymal reaction resulting in a narrowing in the aqueduct to only a portion of the normal lumen. The small pocket of ependymal cells left in the roof (near the top of the picture) and the extensions of the lateral recesses indicate the normal size of the lumen. Not only is the surface of the ependyma irregular but there are several areas in which the ependyma has broken down and been left behind in the progress of the proliferative changes. In the roof is also seen a heavy wall of invasive and productive gliosis that resembles a neoplastic process. Hematoxylin and eosin stain; reduced from × 75.

is what you are supposed to do to save your life. Papa, pray for me. Oh my daddy, stop crying now." On October 27, he twisted one side of the bed linen and said that it was a pile of iron. He blew out his cheeks and showed some rigidities and stiffness mixed with resistance. On October 29, he said, "My tobacco and eyes. I was down there. You told me to go down there and get a drink of water." He grabbed things, closed his eyes, made himself stiff and was restless. He appeared to have hallucinations. He showed tensions of a voluntary character. He had great difficulty in getting up, and when put on his feet fell backward and made his legs stiff. He showed considerable resistance to passive movements, and all active movements were very clumsy. On October 31, he had wide pupils that reacted variably, but at times were practically fixed. He made only inarticulate sounds. There were changing rigidities all over the body, but more so in the legs, which were usually held in flexor contraction. When put on his feet he sank down at the knees. There were jerky movements and tremors of the hands. He seemed to have hallucinations and be almost delirious, staring and pointing about. On November 4, the mental picture was practically the same. He confabulated rather vividly. He would lie in bed most of the day talking to himself and imaginary persons, or singing. He was disoriented and showed impairment in recent and remote memory. His attention, however, was sharp, as he promptly answered all questions directed either to him or to other persons in the room. Upward movements of the eyes were limited, but he looked downward fairly well. Convergence of the eyes was lost. The facial expression showed anxiety. There were some flatness and an occasional twitching of the right side of the face. He would lie in bed with the legs drawn up, flexed at the knees and turned to the left. There was increased tonus in all muscles of the body, especially of the legs. He responded vividly to pinching of the lower extremities. The palmar surfaces of the hands and plantar surfaces of the feet showed a fine desquamation of the superficial layer of the skin. He perspired excessively, was emaciated, had a severe diarrhea and was incontinent. He died on Dec. 1, 1931. The postmortem findings were: syphilitic aortitis, perihepatitis and congestion of the liver, congestion of the spleen, syphilitic interstitial orchitis, pial and arachnoid edema of the brain, general emaciation and decubital sores.

Histopathologic Studies.—The brain stem, spinal cord (fig. 15) and selected areas of the cerebral and cerebellar cortex were examined. The sacral level of the spinal cord showed very little pathologic change. There were some gliosis of the central canal and marginal gliosis, neither of which exceeded the normal. But there seemed to be an increase in the perivascular spaces and of the walls of the vessels in the gray matter between the anterior and posterior horns. The lower thoracic level showed numerous small hemorrhages around Clarke's nucleus, with congestion in the nucleus and chromatolysis of the large nerve cells. At the cervical level of the cord, where the lateral horns were evident, there were rather severe hemorrhages in this horn around the branches of the anterior central artery. These were bilateral. At the lower end of the medulla, just where the central canal opened, there was a severe gliosis along the slit, invading toward the nucleus of the twelfth nerve. At a higher level, where the fourth ventricle was wide open, there were considerable ependymitis and an invasive gliosis involving the surfaces of the eighth to twelfth nerves (fig. 16). The choroid plexus showed reduplication of the epithelial cells, thickening of the connective tissue and of the walls of the blood vessels and numerous hyaline bodies. About the aqueduct of Sylvius in the pons there was ependymitis with productive gliosis as deep as the fasciculus longitudinalis. The vessels were thickened; there was an increase in the capillary bed with enlargement of the perivascular spaces. There was some congestion in

the deeper areas. The same lesion was seen about the aqueduct in the midbrain and, in addition, there was some marginal gliosis with invasive tendencies on the surface of the quadrigeminate bodies. There was also such a lesion involving both the marginal glia cells and the adjacent blood vessels at the base of the brain stem in the recess between the cerebral peduncles and the pons, approaching the red nuclei. A section through the center of the cerebellum, including the dentate nucleus and flocculus, showed ependymitis and vascular disturbance in the dentate nucleus and marginal gliosis in the folia of the cerebellum. The third ventricle and mammillary bodies showed ependymitis and invasive gliosis on all

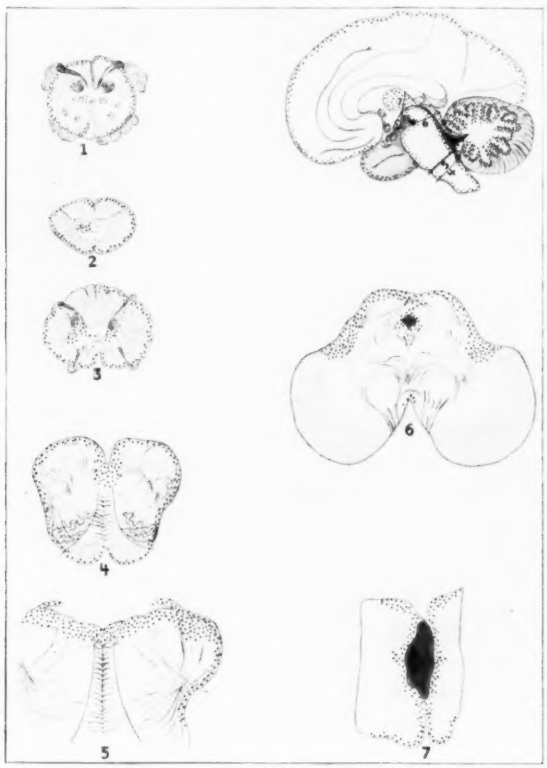

Fig. 15 (case 13).—Appearance of the brain stem.

surfaces. The deeper parts of the mammillary bodies were intact. The gliosis was mostly fibrous, but in areas large masses of cytoplastic glia cells were seen invading deeply into the tissues, especially about halfway up the wall of the third ventricle and also deep in the floor between the mammillary bodies. Fibrous gliosis was also seen about the vessels of the thalamus, more on one side than on the other. The optic nerve was severely injured. Most of the normal markings were lost, owing to the severe marginal gliosis, and there was general loss of myelinated fibers with replacement by a fibrous gliosis and an increase in the interstitial connective tissue. Several areas of the cerebral cortex from the frontal, temporal, motor and occipital regions showed marginal gliosis of the cytoplastic type, involv-

ing the first cortical layer, with numerous areas of marked thickening or irregular hummocks. Sometimes the second layer was also invaded. There were also congestion and small hemorrhages. There were no evidences of inflammation, perivascular reaction or changes in the nerve cells. Thus there were none of the types of reaction typical of syphilis, either of the blood vessels or of the parenchyma.

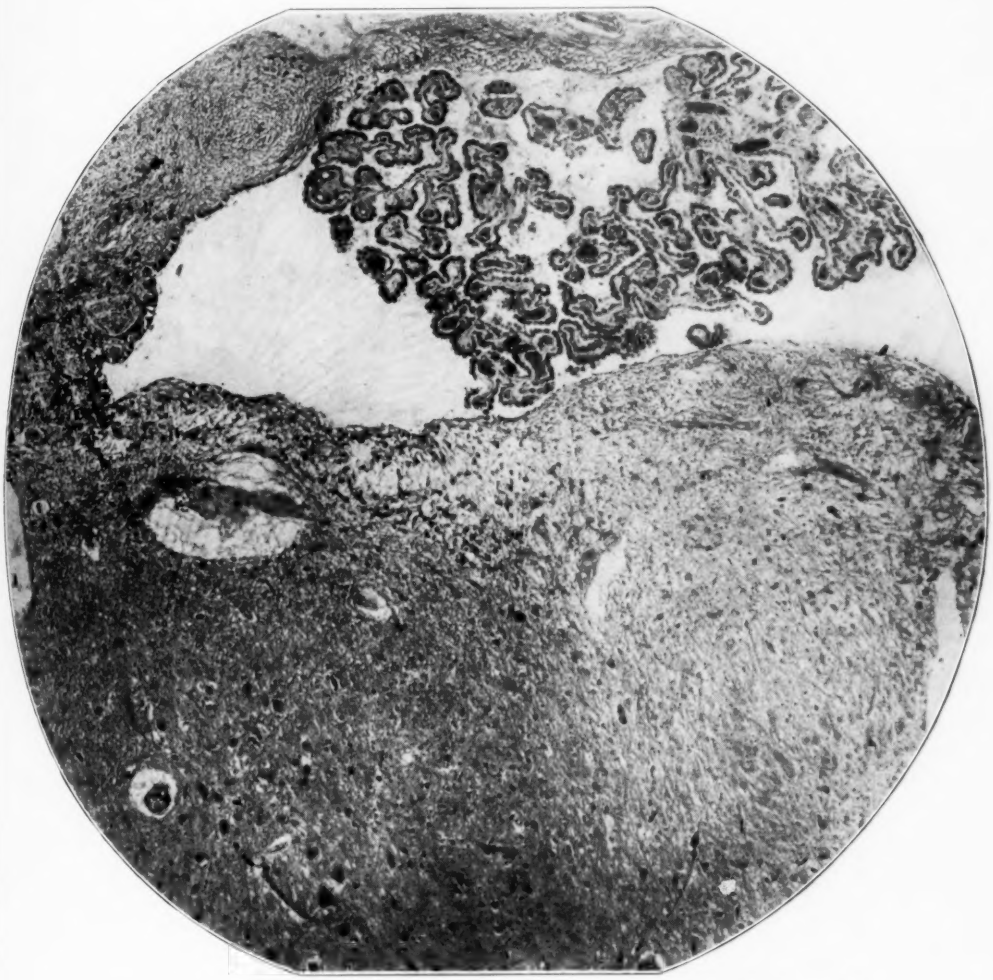

Fig. 16 (case 13).—A section showing the lateral recess and the floor of the fourth ventricle with the choroid plexus at the top and the nuclei of the eighth nerve below. A marked productive and invasive gliosis is seen on the floor and in the lateral recess. The nerve cells in the nuclear centers are normal. The choroid plexus shows some congestive and ependymal changes. Eosin-methylene blue stain; reduced from × 82.

Summary and Comment.—The lesions were typically an ependymitis along the ventricular system and marginal gliosis along the surface of the brain and the

brain stem, with some tendency toward invasive gliosis, which was most marked along the recesses of the ventricles or the depths of surface convolutions and with a predilection for vascular injury to the adjacent gray masses, especially those connected with visceral functions. There was also some reaction in the meninges and the choroid plexus. It is interesting that we can safely say that the syphilitic infection had not invaded the brain and that the pathologic changes found were definitely due to alcoholism and not syphilis, so different are the two types of lesions.

Clinically this patient showed: (1) moderate clouding of consciousness, but with extensive dissociation in thinking; he gave the impression of having vivid hallucinations but not in the sense of occupational delirium; (2) a tendency toward pointing and grasping; (3) asynergia; (4) changing rigidities, in which the psychic element played the important part; (5) severe dissociation in motility, with quick jerky movements; (6) pupillary disturbances, but no other ocular signs; (7) increased reaction to pain, and (8) profound vegetative disturbances. In this case the psychic changes were again in the foreground. The absence of oculomotor signs is again noteworthy. The rigidities were more intermixed with psychic elements than they were in the first group of cases. This case was more chronic than the two others of this group, as the course lasted more than six weeks. In the histopathologic picture the outstanding feature was the predominance of the glial reaction. It is of interest that we were able to demonstrate also lesions in the spinal cord.

Here again we deal with a special group of cases. Whoever has seen such cases will be impressed by the apparently vivid hallucinations and by the wild reaction to the hallucinations. Consciousness is not as clouded, but still the utterances are all abrupt and disconnected. The similarity to severe acute catatonic states is forced on one. In the motility there are many signs of dissociation of a catatonic type. There are aimless blowing of the lips, tightening and stiffening of the body, the assumption of queer bodily postures and catalepsy. In some cases there is a tendency toward rhythmic movements. But these psychomotor movements are still dependent on underlying neurologic factors. There is a marked grasping reflex, and the tensions, although under the influence of the psyche, are definitely similar to the tensions in the first group of cases. Support reactions were not observed. Increased pain reaction was absent in one case and not adequately tested in another. In addition, there were jerky movements very similar to the myoclonic movements seen in acute epidemic encephalitis. It appears that these are irritation phenomena; that there are psychic changes that influence the muscular response and muscular responses that influence the psyche. The neurologic signs are more diffuse and directed more toward the psychic side. The similarity of the picture to an acute catatonic psychosis is certainly a feature of great general importance. These cases differ considerably from the classic picture described by Wernicke. There is a complete lack of oculomotor signs, and the histopathologic picture shows a predominance of glial reaction with a minimum amount

of hemorrhagic reaction. Thus, the group may be looked on as a fairly well defined entity in the cases of encephalopathia alcoholica.

IV. PROLONGED DELIRIUM ASSOCIATED WITH NEUROLOGIC SIGNS

CASE 14.—*Clinical History.*—The patient, aged 36, a brother of the patient in case 4, was admitted on Oct. 10, 1930, with a history of heavy drinking and of having been drinking steadily for three weeks. Two days before admission, he imagined that bears were chasing him. On admission, he was drowsy but nearly oriented. Two days later, he had vivid hallucinations and said, "A horse—a horse—up there." When his ears were irrigated, he said: "I see three girls lying down and three fellows in white—a whole bunch of kids coming to me. There is a nurse. Everything is moving around." He became completely delirious. He pointed to the wall and said, "This human being and that one is holding me back." He showed restless movements of the fingers, plucking at the bed clothes from time to time and picking. He was always grasping and groping. There were rigidities in the arms, with convergence mixed with resistance. There was a support reaction in all extremities, but in spite of this there was a tendency toward semiflexion of the legs. Pupillary reactions were sluggish; speech was slurred. There was a serious cerebellar asynergia. The tendon reflexes were all normal. On October 27, he said: "I made a trip with an air ship last night. I am back in the hotel now. The bed is under me. I don't know the number of the room. I met you on Twenty-Fourth street. There is an old man with whiskers coming." Examination of the blood and spinal fluid gave entirely negative results. He was transferred to a state hospital on November 20, still having hallucinations, but at times was normal for a few hours. He was discharged from the Manhattan State Hospital on April 4 and later reported to our dispensary where he was found to be clear mentally and showed only a slight awkwardness in motility.

Comment.—This is a typical case of delirium. It is mentioned here partly because the patient was a brother of a patient whose case was reported in the first group, and partly because in the picture of prolonged delirium there were signs that were essentially identical with the neurologic signs in the first group, though milder in degree. The signs were the varying tensions, the asynergia and the support reaction.

It should be emphasized that there is some relation between the different types of alcoholic psychosis. In a case of prolonged delirium one will find resemblances to the symptomatology of the encephalopathic cases. But in spite of this, there are different nosologic entities. It would be of interest to study the neurology in cases of delirium tremens from the point of view developed here. There are not only differences between the different groups, but similarities that point to a similarity of lesion in all alcoholic psychoses. It is not clear why in one person alcohol produces a delirium, in another an alcoholic hallucinosis, and in a third an encephalopathia. Neither is it clear why in the first two groups of this series we dealt chiefly with a picture of delirious type, with clouding of consciousness, while in the third group, with catatonic features, there was a predominance of hallucinosis with disconnection in thinking.

V. POLIOENCEPHALOPATHIA ALCOHOLICA COMBINED WITH POLYNEURITIS

Some of the cases of group I showed a mixture of neuritic signs with signs of lesions in the central nervous system. We shall now report cases in which the neuritic signs played a more important part. In some, the neuritis was the predominant feature.

CASE 15.—*Clinical History.*—A woman, aged 46, was admitted to the hospital on May 6, 1931, from her home, with the statement that she had been sick for a month, owing to drink, and that she had spasms that started from a pain in the head and imagined that she saw things. She had started to drink six years before, and drank every winter until she reached a condition similar to the present one; the husband sent her to the country for the summer, where she was away from liquor and regained her normal health. Once, three years before, she had more hallucinations than at present, but she had never been so weak in the legs nor had convulsions until three days before admission. She was emaciated and toxic. There was a pellagroid dermatitis on the dorsa of the hands. All nerve trunks and muscle bellies were tender, and all deep reflexes were hyperactive. The pupillary reactions were adequate, but there were seemingly paralyses of all ocular movements, except for up and down movements. Irrigation of the ears did not produce the reaction of nystagmus. Speech was slurred and bulbar in type; the tongue was edematous and tremulous. Gradually she lost the power to swallow. There was rigidity of the facies, which progressed in a day or two to look like a facial paresis with ptosis, and there were also coarse tremors of the facial muscles that resembled choreiform movements. She was constantly grasping and groping for things, picking at the bed clothes and resisting every effort to examine her or to care for her. The movements were jerky and athetoid. She was incontinent. She was confused and disoriented; she had visions of dolls dancing on the mantelpiece and heard imaginary undifferentiated noises. She complained of dizziness. At times she was fearful, screaming and fighting blindly. She died on May 14. There was no postmortem examination.

Summary and Comment.—This case showed a delirious picture with: (1) clouding of consciousness; (2) paralysis of ocular movements, except for up and down movements; (3) absence of caloric nystagmus; (4) choreiform and jerky movements; (5) grasping and groping, and a grasping reflex; (6) bulbar speech; (7) peripheral neuritis, chiefly shown by pain and tenderness, and (8) pellagroid dermatitis. The similarity to cases in the first group is obvious. The neuritis is evident from the nerve tenderness. There was no paralysis or diminution in reflexes.

CASE 16.—*Clinical History.*—An Italian girl, aged 28, was transferred from another hospital on Jan. 21, 1931, with a diagnosis of Korsakoff's syndrome and polyneuritis. On admission, she was disturbed with hallucinations in the visual and auditory fields, disoriented and ataxic. Her past habits had been irregular. It was generally believed that she drank a good deal, both socially and by herself; the exact amount or nature of the alcohol was not known. For several months previous to admission, she had become run down, failed to eat regularly and complained of weakness in the legs; she vomited food and was depressed. She was poorly nourished; the body everywhere was hyperesthetic and tender, especially over muscle bodies and nerve trunks, more particularly in the lower limbs. She also complained of numbness and heaviness in the legs. The pupillary reactions

and all ocular movements were normal, and there was no nystagmus. There were constant fine tremors in the facial muscles and tongue, and unsteadiness of head movements. There were ataxia and coarse tremor of the arms, with choreiform involuntary movements and queer rigidities and postures. The tendon reflexes in the arms were hyperactive. There were weakness and loss of power in the legs, with absent tendon reflexes and muscular atrophy, all of which progressed during the course of the illness. She was under observation for four months until death on May 31. The heart, lungs and abdomen were normal on repeated examination, except for a low grade endocervicitis which responded to treatment. All laboratory tests, including examination of the spinal fluid, a Wassermann test, chemical analysis and culture of the blood and urinalysis, gave negative results. She showed an irregularly elevated temperature, sometimes septic in type, which was accompanied by a normal leukocyte count. From time to time she passed into a state of shock without apparent cause, when the temperature dropped suddenly and she became cyanotic and nearly pulseless, but she always responded to stimuli. She was incoherent, rambling, emotionally unstable, especially irritable, with frequent hallucinations and confabulations, inattentive and uncooperative. The clinical picture did not change much in the course of the next four months, except for a progressive weakness and atrophy in the legs, progressive inanition in spite of every effort, including a diet of a high vitamin content and blood transfusions, to help her gain strength, and a loss of emotional coloring and intellectual alertness in the mental picture with a decrease in hallucinations and confabulations. On January 23, she said (What are you doing here?): "I live with my husband—what do you think—I live with other men? You let those people talk and torture me and keep it up. You took a chicken off my family. I had a chicken at home." (I shall tell you a story.) "I shall be delighted to hear it. Why the Hell did you come in my room when you didn't know me on Wednesday? When I was crying and throwing my face and ribs, I asked my mother not to take me home. She didn't want to take me home. They were all scheming me. Once you looked into my eyes." On February 5, she said, "I don't think it was ham—I didn't eat any ham." (Do you know who I am?) "Yes, I know who you are. You know that I know who you are." (What is the difference between a horse and a jackass?) "I don't know your name. I suppose I am a jackass. Don't bother me. I don't mean nothing. I never did. I don't—are you trying to get rid of me?" At this time her hands showed a coarse tremor and were very restless. She was irritable, had a distressed expression and said, "Oh, my God." On February 9, she said, "Oh I got my hand on it. I didn't put it on there purposely." There were many small movements of the fingers like coarse tremors, but sometimes individual fingers would jerk suddenly. By this time the legs were entirely paralyzed and very sensitive to touch. The tendon reflexes of the legs were entirely absent. She was easily excited and had difficulty in breathing. She died on May 31. The autopsy was limited to the head.

Neuropathologic Studies.—The brain stem (fig. 17) and selected areas of the cerebrum and cerebellum were studied. A section of the lower end of the medulla showed ependymitis and a severe loose gliosis where the canal opened up and joined the choroid plexus, with fragmentation and breaking down of the tissues. The lesion involved the nucleus of the cuneatus, but the nucleus of the twelfth nerve was free. At a higher level of the medulla a similar lesion was seen. It was also present at the level of the pons below the decussation of the brachium conjunctivum, but in a more lateral position, as it was always most severe at the lateral recess of the ventricle where the floor joins the choroid plexus. In the

aqueduct of Sylvius the ependymitis was productive and encroached on the lumen. The invasive gliosis impinged on the nucleus of the fourth nerve slightly, and invaded the quadrigeminate bodies moderately. A section through the third ventricle and mammillary bodies showed ependymitis with productive gliosis of a fibrous type in the wall of the third ventricle, on the surface of the mammillary bodies and entirely replacing the commissure between them. The cerebral and cerebellar cortex showed small patches of subpial gliosis, especially at the tips of the convolutions. Where the cerebellar lobules (fig. 19) were involved, the lesion included the molecular layer, the Purkinje layer and a little of the granular layer.

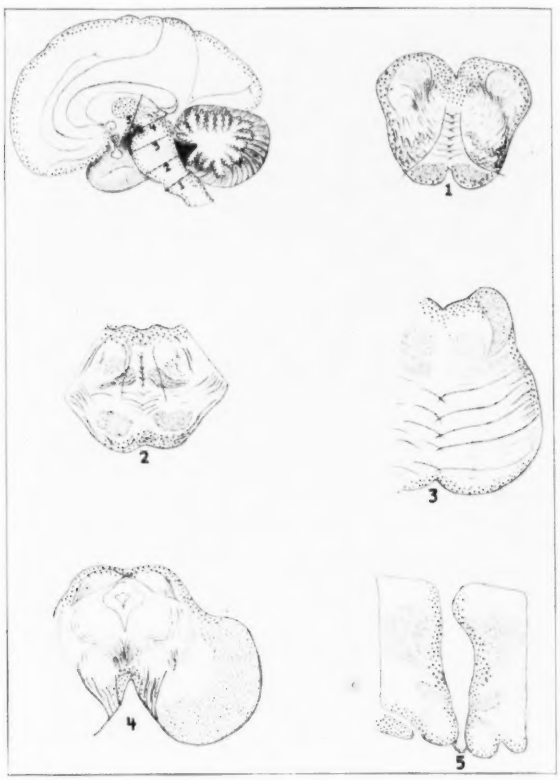

Fig. 17 (case 16).—Appearance of the brain stem.

The Purkinje cells were lost and there was a retracted glial scar. Only the first and second cortical layers of the cerebrum (fig. 18) were involved. The optic nerve showed an almost complete replacement of myelinated fibers by a dense network of glia fibers.

Summary and Comment.—The localization of the lesion was the same as in the other cases, namely along the ventricular ependyma and surface of the cortex and brain stem, but it was more chronic and less invasive and was characterized mostly by ependymal and marginal gliosis and little or no underlying vascular reaction.

Clinically, the case showed: (1) a delirious picture in which inhibition and akinesia later played an important part; (2) a peripheral neuritis, especially in

the legs, with paralysis; (3) rigidity and tendencies toward queer postures in the arms, and (4) severe vegetative disturbances, leading finally to death. The chronic progressive course in this case was remarkable. There were some features similar to those of group I, but the neuritis was the most prominent part of the picture. It was an interesting mixture of a severe polyneuritis and an incomplete encephalopathy similar to the condition in the other cases.

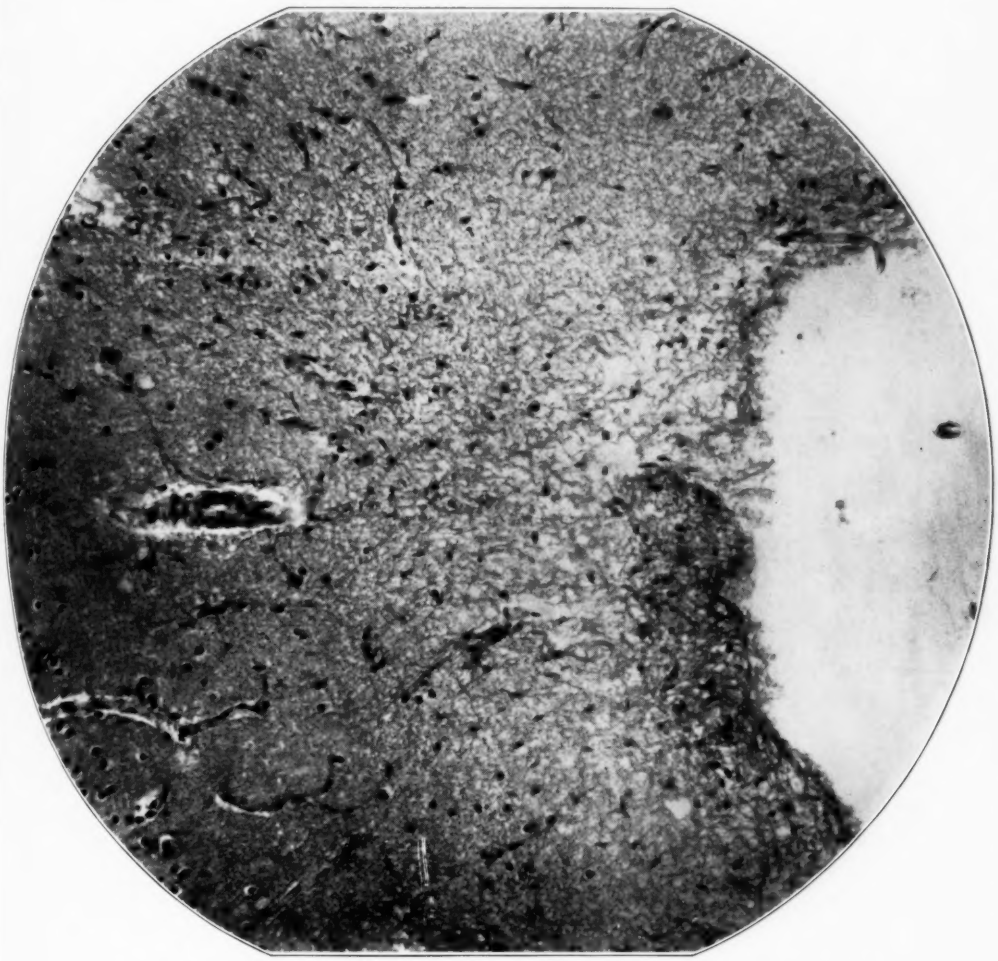

Fig. 18 (case 16).—A section from the margin of the cerebral cortex in the dip of a convolution showing the marked marginal astrocytic gliosis involving the first layer with congestion and proliferative changes in the vessels that invade the second layer from the pia. Eosin-methylene blue stain; reduced from × 250.

CASE 17.—*Clinical History.*—A woman, aged 44, had been in another hospital for several weeks and had been taken home recently by her husband. He stated that she had drunk for years, and for about two months before admission had been unable to eat or to walk and seemed to be losing her mind. At the other

hospital she did not improve and was not well when he took her home. On admission, on Jan. 19, 1931, she was disoriented, apathetic and unable to cooperate. She answered most questions with her name but said, "It is a very complicated matter. I am at One Hundred and Forty-Fourth street." She was hypersensitive all over the body, especially in the legs. Both arms were very weak. In extension,

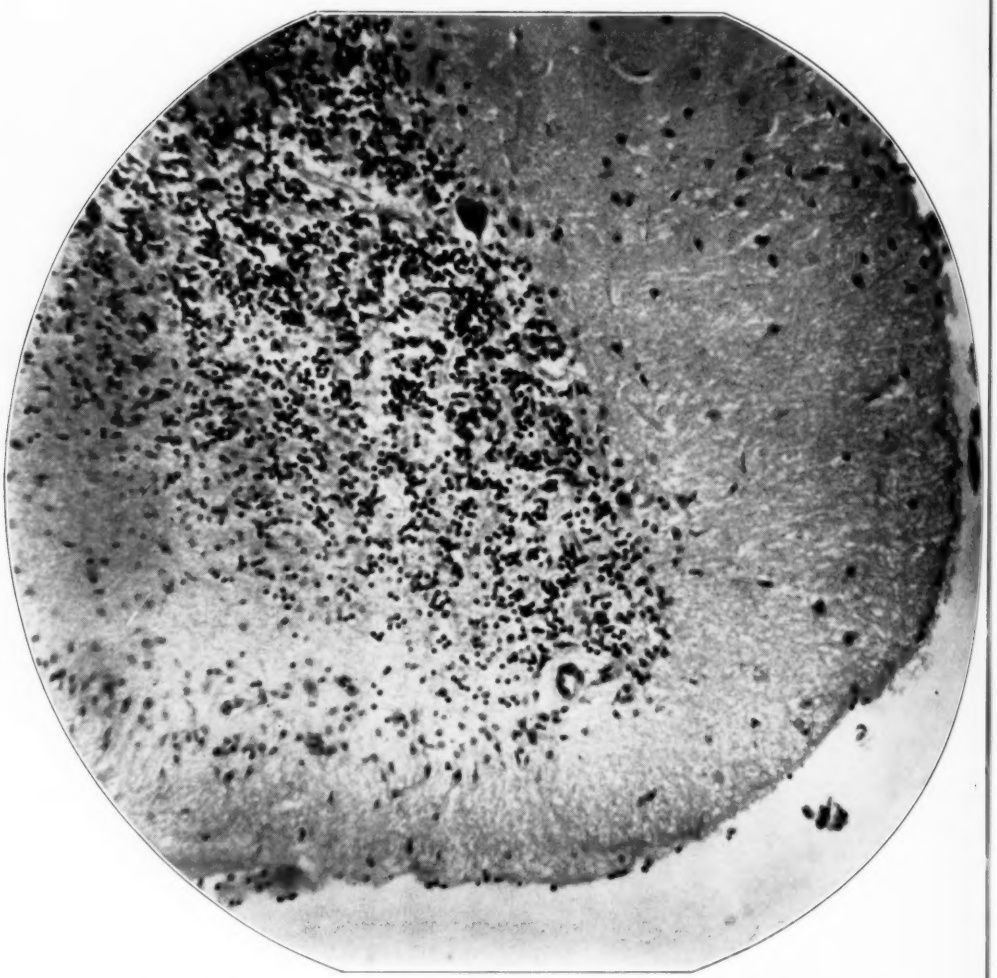

Fig. 19 (case 16).—A section from the tip end of a lobule of the cerebellum showing the normal surface on the left while on the lower side is shown a lesion with a loss of the Purkinje cells and some of the granular cells with a glial reaction which has caused a retraction of the marginal layer. Eosin-methylene blue stain; reduced from × 250.

the left arm tended to pronate and converged at the shoulder, while the right arm raised itself and diverged. There were extreme weakness and hypotonia in the legs so that she could not stand. Patellar and achilles reflexes were absent. There

was no Babinski reaction. There was nystagmus on both sides, but more on the right. The patient also had difficulty in moving the eyes, but lateral movements were more difficult than convergence. The left pupil was larger than the right; both reacted promptly. The optic fundi were normal. The Wassermann reaction of the blood and spinal fluid was negative, and all other tests of the spinal fluid gave negative results. In the next few days the nystagmus changed, showing a rotatory component, with the quick movement in the counter-clockwise direction, and also a vertical component. She sometimes remained in cataleptic attitudes. Irrigation of the ears did not provoke any nystagmus, past pointing or deviations of the arms or trunks. Her utterances were abrupt and disconnected. She said: "I feel like punching you in the nose." (Why?) "Oh, I just feel that way." (Is that the kind of a girl you are?) "You mean is that the kind of a girl I turned out to be. I feel like fighting." (Where are you?) "Still in the synagogue." (What are you doing there?) "Looking at you." (What year is it?) "Nineteen fourteen—now here he comes with the questions." On January 29, there were rigidity of the neck and drowsiness. She died on February 1. There was no postmortem examination.

Summary and Comment.—Clinically, there were: (1) a Korsakoff's psychosis; (2) marked polyneuritis all over the body; (3) nystagmus, but no reaction to caloric stimulation of the ears; (4) difficulty in lateral movements of the eyes, and (5) some tendency toward cataleptic postures. An atypical Korsakoff's psychosis and polyneuritis were in the foreground in this case, but there were also signs pointing to a lesion in the central nervous system similar to that in the foregoing descriptions.

CASE 18.—*Clinical History.*—A woman, aged 42, was transferred from a medical ward, to which she had been admitted on March 16, 1931, with a complaint of difficulty in walking for two months. She had weakness in both legs, with loss of reflexes and sensory disturbances up to a definite level at the third lumbar segment. There was also weakness of the upper extremities, with exaggerated reflexes. There were nystagmus in all directions, disturbance in speech and psychic troubles. She complained that she had not had a bath in ten days, that the physician gave her morphine in her dining room, that a colored man pulled her toe and that her husband and everybody were all singing and having a good time. All serologic tests of the blood and spinal fluid were negative. She was transferred to the psychopathic division on March 25, where she was found to be confused, especially at night, confabulatory and disoriented. She said, "I would like to go to the hospital and have my knees operated on." There was spasticity of the right arm, with hyperactive reflexes and a positive Hoffmann sign. The left arm showed tremor. She lay in bed with the legs flexed and complained bitterly of pain and tenderness in them. The achilles and patellar reflexes were absent, and there was no Babinski reaction. There was difficulty in stretching the legs, and she could not move her feet. There were: a slightly stiff neck, nystagmus to both sides, slurred speech and a stiff facial expression. The eyegrounds were normal. Four days later, she was oriented. She said, "Doctor, if you could answer the question for me why I am here and I had a million dollars, I would give it to you. I went to church yesterday." (Are your legs all right?) "Yes. I have a peculiar way of dressing. After I have my bath, I always put on my shoes and stockings first and then I take a walk around the bath room and kitchen and start to dress. I have been doing that more so since my legs are so bad." The patient was unable to walk, but there had been some improvement in the paresis. There was improvement in the arms also, but the facial expression was still stiff. The

nystagmus was disappearing and on April 1, the Hoffmann sign had disappeared. From that time on there was steady improvement until she was discharged on April 27, when she was almost free from symptoms with the exception of hypersensitivity, especially in the legs. Before discharge she admitted drinking regularly. Subsequent efforts to follow up this case were not successful as the patient moved from her former address.

Summary and Comment.—This case showed: (1) neuritic paralysis of the legs, with unusual distribution of the sensory disturbances; (2) confusion of a toxic type; (3) spasticity and increased reflexes in the upper extremities; (4) nystagmus, and (5) bulbar speech. It was evident from the history that we were dealing with an alcoholic neuritis, but there were also signs of lesions of the pyramidal tract and bulb.

CASE 19.—*Clinical History.*—A woman, aged about 49 years, was admitted on Feb. 21, 1931, with a statement from relatives that she had been on one of her periodical drinking spells for the previous three weeks. She complained that her feet were in straps and that adhesive tapes were around the tips of her fingers. She continually tried to remove these tapes and picked imaginary threads from her body. She was confused, disoriented and misidentifying. She had crying spells. She was unable to walk. On admission, she said: "There is a nail on the top of my foot. I don't drink. My husband is here; he can tell you. My fingers feel as if there were needles in them. Please take my stockings off." (She had none on.) "I will be 75 in April." She had an alcoholic facies. Her voice was high pitched, with a peculiar intonation. The retinal disks were injected. The pupils reacted sluggishly to light. There was a quick nystagmus to the right; on the left the nystagmus consisted chiefly of the slow component. There was good convergence of the eyes, but she had difficulty in keeping the eyes to the left. She lay in dorsal decubitus, unable to move herself to either side, although she could use her arms. The lower limbs were held in a frog position, with the knees flexed and rotated outward and the soles together. She was unable to move the proximal segments, though she could move the toes freely and the foot to some extent. All deep reflexes were absent. There was definite weakness in the upper extremities, with moderate atrophy of the interosseal muscles, involuntary movements of the hands and wrist and a pill-rolling position of the hand. Careful examination of the sensibility was not possible. Pain did not seem to bother her much anywhere. She said, "It feels like meat, like food." When a cross was drawn on her hand with the examiner's finger, she said: "It feels like the button on a coat. I think it is the button from your vest." When a cross was drawn on her hand with a pin, she said: "It feels like the edge of an iron burning me. It's like a cord. It's like sheepwool." When asked if she knew that she was paralyzed, she said: "I got up about four-thirty and I got my daughter's lunch and all of a sudden there was a numbness in both hands. I would like to know what that smell is you put in my eyes. I will tell you how I know. There was a young girl and she had two doctors and I stayed with her until the doctors came. They weren't in the room very long when they put this stuff in the room." (Where were you yesterday?) "I was out this morning. I walked to church and I came home with the lady." (But you are paralyzed.) "I asked you if you would take me and you said if you felt good you would." She was very inattentive. When shown the picture of a silver fox, she said: "I say that is out in the woods. It looks like those white lions." She did not change much in the next few days, and died of bronchopneumonia on February 27. There was no postmortem examination.

Summary and Comment.—This case showed: (1) delirious features; (2) severe peripheral neuritis, and (3) nystagmus and impairment of lateral movement of the eyes. The neuritis was the predominating feature, although the nystagmus suggested a lesion of the brain stem as well.

CASE 20.—*Clinical History.*—A man, aged 52, was brought to the hospital on April 8, 1931, after having been found on a floor by the ambulance physician, uttering incoherent babble and betraying the existence of auditory and visual hallucinations. He had an alcoholic breath. He admitted drinking excessively. On admission he was dull, shaky and tremulous. He said: "I am a little nervous. I have been here before. I am a little nervous. I was a little drunk. My mother died and my two brothers—no, I take it back—my mother's brother—they are dead all right. I didn't hear things, but somebody in this hospital stole $5,000 from me." (What is the date?) "It is the 14th of January, 1878—no, that's my birthday—it is 1931. I was home yesterday, seeing my mother and two brothers." He was silly and euphoric, and did not understand his present situation. He had a flaccid face, with tremors of the lips and irregular pupils that responded sluggishly to light. He was apraxic in the use of his tongue, and when he tried to move it there were associated movements in the muscles of the face. He had great difficulty in opening his mouth. He was emaciated; the skin of the hands was dry and scaly, especially between the fingers, and there was edema of the ankles. The spinal fluid was normal in all examinations, including the Wassermann reaction, which was also negative with the blood. During the next few days hallucinations continued and he was restless. On April 14, he said: "I had a nervous breakdown. To tell the truth I lost my brothers and my mother. Four people are dead in my house. I was home last night and I was home this morning." His expression was dull and his reaction euphoric; he continued to confabulate. He showed marked polyneuritis, with ptosis of the eyelids, weakness in all extremities, absent tendon reflexes, tenderness all over the body and a bilateral foot drop. On April 15, he was oriented for place. He said: "I didn't go out today, and I am tired. I will go out every day and get some fresh air." He confabulated at suggestion. He bent down to pick up imaginary glasses, and said, "I am going to be operated on for my throat." He fumbled with the bed clothes and was always grasping at things. He also had a grasping reflex. Even the grasping was ataxic. He made rhythmic movements of the right leg and showed an intention tremor of the hands. He tended to supinate the arms, and showed weakness on pronation. There was marked atrophy in the muscles of the hands, and a wrist drop was present. He made many small meaningless movements with the fingers, and tended to hold the hands in cataleptic positions from time to time. There was a staring expression, with no pupillary disturbances, but with some difficulty in sideward movements of the eyes. The pseudo-pellagrous erythema of the hands and feet persisted, producing ulcerations of the toes. During the next few days all the symptoms progressed. He said: "I am pretty good. I am in Norwood, New Jersey. I got up late this morning. I am in my home. The train is the best thing for me to go over." He had a tendency to perseverate, recognized objects, obeyed commands and made many delirious movements. The emaciation had become more marked; the atrophy in the lower extremities had progressed; the tendon reflexes remained absent; definite paresis of the abducens muscle had developed on the right, and less definitely on the left; the pupillary reactions had become poor, the right one being nearly absent. On April 23, gangrene of the toes of both feet had developed. He died on April 29. There was no postmortem examination.

Summary and Comment.—In this case there were: (1) a delirious picture with later Korsakoff features; (2) marked polyneuritis; (3) grasping and groping tendencies, and a grasping reflex; (4) cataleptic attitudes and athetoid movements of the hands, and (5) pellagroid changes in the hands and feet, which progressed. In this case the catalepsy and the psychosis pointed to a lesion of the central nervous system in addition to the polyneuritis.

In all of the polyneuritic cases discussed so far there was definite evidence of a process in the central nervous system such as was found in the other groups of cases. In case 15 the signs of lesions in the central nervous system dominated the picture, so that this case links the two groups together. In case 9 there was a marked neuritis in connection with the demonstrated lesion in the central nervous system. Rigidities in the arms, catalepsy and a tendency toward athetoid movements were rather common in most of the cases. But in case 19 there were only the nystagmus and impaired lateral movements of the eyes to suggest the central lesion. In case 17 the absence of caloric nystagmus and difficulties in ocular movements were the most significant features, although there was also spontaneous nystagmus. There are two cases in the group with marked pseudo-pellagrous changes in the skin of the hands and feet. All cases showed a psychosis in which clouding of consciousness played some part. In other cases there was confusion; in some of these, as the confusion tended to subside, a picture was left that was akin to a Korsakoff psychosis. In case 18 there were signs of a pyramidal tract lesion. Signs of such a lesion also played some part in the following case.

Case 21.—*Clinical History.*—A colored man, aged 50, was transferred from Harlem Hospital on Feb. 3, 1931, complaining of a tingling sensation in the legs and arms and being unable to walk by himself. He said that he drank heavily. He said that some one was after him to take his money. He stated: "I feel fine, only I can't move my hands. I don't know why. I guess I am paralyzed." He now denied that he thought that some one was after him. Orientation at this time was good. He had paralysis of the right arm, especially at the shoulder, but retained ability to flex the forearm. The left arm showed more power than the right, but was also weak. The tendon reflexes were sluggish. Gait was staggering, with a positive Romberg sign. Achilles and patellar reflexes were hyperactive on both sides, and there was a bilateral Babinski sign. There was a definite heel-to-knee ataxia. Pes cavus of both feet was present. There was tenderness of the muscles and nerve trunks. Pain sensation was intact; the patient was even hyperesthetic. In both lower limbs a pin prick was felt as electricity spreading upward, but on the fingers and dorsal surfaces of the hands a prick was felt as a light touch. Postural sense in the fingers was lost. Otherwise he was also hyperesthetic in the upper limbs. The pupils were a little irregular and the reaction of the right one to light was defective. There was a bilateral partial ptosis of the eyelids. Serologic tests of the blood and spinal fluid were completely negative. Toward the end of February, atrophic disturbances developed in both hands, and the skin over the backs of the hands became broken, coarse and covered with a fine brownish-white desquamation. Examination of the urine, blood and internal organs gave negative results. Electric reactions in the muscles, even in the para-

lyzed ones, were normal. The patient began to improve rapidly in March and was discharged on March 17 with only some weakness in the arms and a persistent Babinski reaction. An effort was made to locate him in December, 1931, but he could not be found.

Summary and Comment.—This case showed: (1) severe polyneuritis, without mental symptoms; (2) bilateral nystagmus; (3) bilateral partial ptosis; (4) a persistent Babinski sign, and (5) pellagroid changes of the skin. Again, the clinical symptoms give evidence of a cerebral lesion, such as was found in the encephalopathic cases. The predominating glial changes of a chronic character that we found in the one typical case of this group gives some idea of the histopathologic changes of the central nervous system that accompany the polyneuritis. Almost any possible combination of neuritic and encephalopathic lesions may occur. We shall not attempt here to discuss alcoholic neuritis. The common coincidence

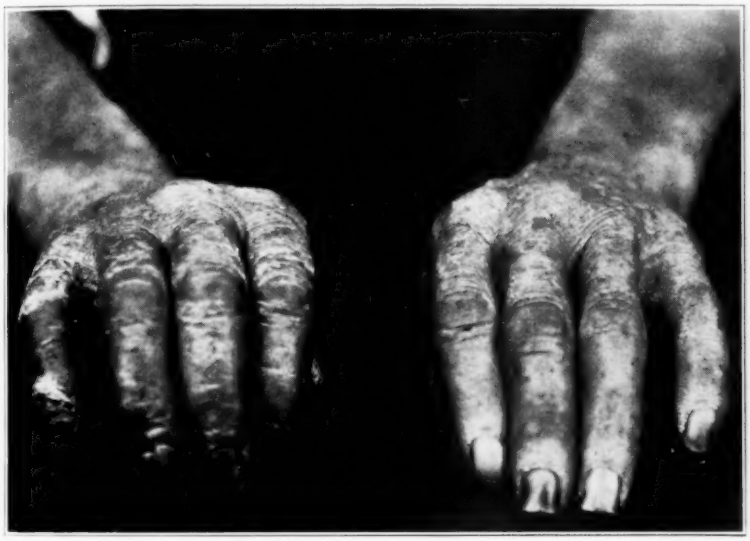

Fig. 20 (case 22).—Photograph taken on Jan. 7, 1931, showing the trophic disturbances of the hands.

with pellagroid changes of the skin may be mentioned again. Nystagmus and changes in the Bárány reactions are common in cases of this group. The one case coming to autopsy showed that the changes in the central nervous system are of a chronic progressive type.

PROBLEM CASES AND FURTHER QUESTIONS

In order to show the great variety of questions involved, we report the history in a case of alcoholic neuritis with an unusual trophic disturbance.

CASE 22.—*Clinical History.*—A man, aged 61, was admitted on Dec. 18, 1931, with a history of chronic alcoholism. He complained of loss of sensation in both hands. Physical examination showed edema of the hands, and atrophy of the skin with blisters and redness (fig. 20). There were also erythema and edema of

the feet. The cardiovascular-renal system was normal. The Wassermann reaction and chemical composition of the blood were normal. Neurologic tests showed paralysis of both forearms, with slight atrophy of the interosseal muscles. The electrical reactions showed a slight quantitative diminution. The tendon reflexes in the arms were exaggerated. The reflexes were otherwise normal. The pupils reacted normally to light. The patient was disoriented for time and showed an organic type of confusion. In the next few days the trophic disturbances in the hands and feet increased. There was edema of the hands. The left foot showed a laceration over the dorsum of the toes and a diminution to sensitivity for pin prick. The vessels were palpable and seemed to be of good quality. The skin of the hands appeared like roast beef on the dorsal surface, and was thick and unyielding on the volar surface. The interossei and digiti quinti muscles were wasted, and there was weakness in all finger movements. The power of extension was better than the power of flexion. There was a glove type of hypalgesia for pin prick extending to the middle of the forearm. Both hands showed a livid bluish color. The hands were tremulous and there was convergence of the outstretched arms.

Summary and Comment.—This was a case of demonstrated neuritis, with trophic disturbances of the hands and feet. According to the history the etiologic factor was alcohol. This was probably a special type of neuritis in a senile person. There was no evidence of vascular disturbance that could cause the trophic disturbance. The patient subsequently improved and was discharged.

The following case is reported because of its similarity to tabes dorsalis.

Case 23.—*Clinical History.*—A woman, aged 58, was admitted on Jan. 26, 1931, who said: "I feel all upset. I am afraid I am going to die. I had a nervous attack four or five days ago." She confessed that she drank a good deal. She was disoriented, agitated and depressed. She moved her hands restlessly, picking at her hair. The optic disks were pale. The pupils were small and reacted sluggishly to light. The tendon reflexes of the arms were normal. The outstretched arms showed marked convergence at the shoulder and elbow, and there was tremor of the hands, but there was no other disturbance in the motility of the upper limbs. In the lower extremities there was marked loss of power and hypotonia, especially in the muscles acting on the knee joints. Power at the ankles was better, but she could not stand or walk. The heel-to-knee test was performed in an ataxic manner, with the big toe held in the Babinski position. The tendon reflexes in the lower limbs were absent. The knee joints were enlarged like those in a tabetic knee. Roentgen examination showed some exostosis of the articulating surfaces. She was constantly making small movements with the feet, usually abduction. The sense of posture in the toes was lost. Sensibility was impaired in a stocking formation to the upper third of the leg. When a line was drawn on the foot with a pin, she said: "It was something wet or something. It was just one point like a dot." When two parallel lines were drawn she said, "I feel something sticking in my foot." When three parallel lines were drawn she felt it as "one mark." When a line was drawn on both feet she felt it only on one foot. When two spots were touched on the left foot, she felt three spots. When a cross was drawn on the left foot with a pin, she felt two or three burning spots with a long after-effect. When a cross was drawn on the right foot, she felt a circle. The Wassermann reaction was negative with both blood and spinal fluid. The colloidal gold curve was flat and the spinal fluid was otherwise normal. Psychically, the patient showed impaired orientation and slight mental deterioration. She

was transferred to Manhattan State Hospital on Jan. 31, 1931. A report from that hospital was: "She was in a restless state, voluble and displaying distractibility, with fluctuation of mood; she claimed that she was unable to walk due to numbness and stiffness of the legs, and complained of dizziness. The biceps and knee jerks were absent; the Babinski reaction was positive on the left side. Eyegrounds showed early retinal arteriosclerosis. The Wassermann reaction of the blood was negative. The general condition improved, and in June she was able to leave her bed without assistance; in July she was up and about and was noted to be oriented in all spheres, although recent memory was somewhat defective. She was paroled on September 7 and reported on October 2 when she was still weak and unsteady on her feet due to residual alcoholic neuritis, but she denied any further use of alcohol since discharge.

Summary and Comment.—This patient showed a picture that was suggestive of tabes dorsalis. There was even enlargement of the knees suggesting a tabetic arthropathy, but there was no syphilitic history and serologic tests were negative. She was alcoholic and recovered. There were disorientation, convergence of the arms and a tremor of the hands. Thus, this was not a case of tabes dorsalis but of alcoholic neuritis, in which the spinal cord was also involved. Also, in a case of Korsakoff's psychosis with polyneuritis of certain alcoholic origin, we have found disturbances of sensibility that were similar to those reported in this case. Stein and von Weizäcker [37] considered these changes as typical for central (spinal cord or higher) lesions of the sensory pathways. To what extent the spinal cord is involved in alcoholic neuritis is an interesting question. We found histopathologic changes in the spinal cord in case 13. We hope that in later investigations we shall be able to consider this question more fully.

The following case is of interest because it simulates syphilis of the central nervous system, with special midbrain symptomatology.

Case 24.—*Clinical History.*—A woman, aged 29, was brought to the hospital on June 7, 1931, with the statement that she had been drinking for a week. She was drowsy, lethargic, too weak to walk, maudlin and tremulous, and smelled of alcohol. On June 8, she said, "I get drunk about once a month; this is March." She was stuporous, confused and disoriented. She was well nourished, but dehydrated. The internal organs were normal. The pupils were small, but reacted to light. On June 9, she was worse; she could not be aroused, and responded very slightly to pressure on the supra-orbital nerve. The pupils were unequal, the left being larger than the right, and did not react to light. The tendon reflexes were present and equal; there was no stiffness of the neck, and the Kernig test was negative. She was incontinent. On June 11, she could be awakened and it was discovered that she had left facial paralysis and ptosis of the left eyelid; the left pupil was constricted and inactive to light, and there was limitation of ocular movements on this side. The biceps reflex was absent on the left, and the left hand grip was weak. The knee jerks were absent bilaterally, but the Babinski response was negative. A spinal tap was done on June 12, and gave negative results in all examinations, except that the colloidal gold curve was reported to be 433221000. The spinal tap was repeated on June 22, and gave entirely negative results. On June 17, she was brighter, but there were still ptosis of the left eyelid and weakness of the left side of the face; the left pupillary reaction was incomplete and the tongue deviated to the left. There were flexion tendencies,

37. Stein, H., and von Weizäcker, V.: Zur Pathologie der Sensibilität. Ergebn. d. Physiol. **27**:41, 1928.

especially in the left arm. The tendon reflexes in the arms were present. There was no Hoffmann reaction, but a positive Meyer reaction was present on both sides. The patellar and achilles reflexes were absent. There was no Babinski response. There was a slight soreness of the calf muscles of the legs. On June 23, she said, "I went out last night to buy a pair of stockings." (How much did you pay?) "Ninety-eight cents." (What color were they?) "I always buy black. I know you are a jollier. What is the use of living if you can't get a laugh?" When she tried to walk and was unable to, she said, "I can't walk without my shoes." She tended to fall backward and showed some retropulsion. Ptosis of the left eye persisted. There were nystagmoid movements on looking to the left, and upward and downward movements of the left eye were impaired. The pupillary reaction was sluggish in the left eye, but prompt in the right eye. Both arms showed strong flexion at the elbows, the left more than the right. There were no other types of rigidity in the whole body, and no troubles in sensibility. On June 29, she was showing improvement, although she complained of double vision; she still had nystagmus on looking to the left, and the left pupil was a little larger than the right and still reacted sluggishly to light. However, the ptosis had improved. She was oriented and no longer confabulated. She was discharged on July 7, apparently recovered. On Dec. 15, 1931, a social worker visited her home and met her coming from a speakeasy under the influence of liquor. She dragged her right foot and kept the left eye closed (ptosis); when she talked, there was an evidence of slurring. The neighbors said that she was nearly always in this condition.

Summary and Comment.—In this case, with a negative Wassermann reaction, we found: (1) a Korsakoff type of psychosis; (2) ptosis of the left eyelid; (3) an incomplete reaction to light in the left pupil; (4) flexor tendencies, especially in the left arm; (5) absence of patellar and achilles reflexes; (6) tenderness of the muscles of the legs; (7) a tendency toward retropulsion, and (8) no disturbance in tone. Until it was known that the serum was normal we thought we were dealing with a case of cerebrospinal syphilis. A closer study of the course of the disease made the diagnosis of an atypical case of alcoholism certain. There were a history of alcoholism, the Korsakoff psychosis and the neuritic signs. Besides this, the patient showed midbrain symptomatology, with ptosis, impaired ocular movements and increased flexor tendencies, all on the left side. Schilder and Hoff [34] consider the absence of persistence of tone as a reliable sign of midbrain and striopallidal lesions. There was also retropulsion. In this case the alcoholism had caused a rather unusual symptomatology. Apparently the variety of neurologic symptoms that can be produced by chronic alcoholic intoxications has been underrated. The neurologic symptomatology is extremely variable; still it is evident that it always centers about symptoms that are due to the characteristic neuropathologic findings in the central system.

COMMENT ON THE NEUROPATHOLOGIC FINDINGS

In all seven cases here reported in which neuropathologic studies were made, as well as in several others not included in this report, there have been demonstrated the same fundamental principles in both localization and type of lesion.

The first principle is that the lesion always occurs in parts of the central nervous system that are adjacent to spinal fluid spaces, such as the surface of the ventricular system and the surface of the brain and

brain stem; in other words, the lesion is always marginal. Furthermore, the lesion is usually more severe where the spinal fluid flows least freely. Thus, when it occurs on the brain surface, it is most often in the depths of the convolutions. In general, however, it is more severe in the ventricular system than on the outer surface of the brain and brain stem. In the ventricles it is most severe around pockets and recesses. Within the fourth ventricle, the lateral recess beneath the restiform body is an area of predilection, consequently involving the nuclei of the eighth nerve. Severe lesions are also common about the aqueduct of Sylvius, and in the depths of the floor of the third ventricle, about the hypophyseal recess, including the mammillary bodies and the optic chiasms, which are doubly exposed both by their relationship to the floor of the third ventricle and by the recesses about the base of the brain. These data suggest that the spinal fluid contains the noxious agent. Of course, the problem is not so simple, but if it were, what might one assume this agent to be? Is it the alcohol itself? It is known that alcohol may be found in the spinal fluid after heavy drinking. Dobrovatzky [38] has shown that alcohol, or at least some related reducing substance, may be present in the brain substance in persons who have died of acute alcoholism; he stated further that it is present in largest quantities in parts of the brain which he assumes, from clinical analogy, to be most affected, namely, in the cerebellum and vegetative centers. The earlier views of von Monakow [39] suggested that alcohol in the blood reduced its oxidation powers and also attacked the lipoids of the nervous system, especially the myelin, thus assuming that this was the cause of the alcoholic neuritis. Although we have not as yet made an exhaustive study of the peripheral neuritis, the distribution and type of the lesion within the central nervous system do not argue for this sort of disturbance. Neither is there any evidence of atheromatous changes in the vascular system as a result of circulating alcohol. On the other hand, in many patients with chronic alcoholism an encephalopathia does not develop. The question may also be raised as to whether the cause is the alcohol per se or some contaminating substance which it contains. Recent experience in some parts of America with the so-called ginger paralysis following the use of fluid extract of ginger as an alcoholic beverage, has led to investigations, with the result that Vonderahe [40] and others have found that a contaminating substance, tri-ortho-cresyl-phosphate, is responsible for the neuritis of the lower limbs, reaching the peripheral nerves from the circulation and producing a lesion which ascends to the anterior horn cells. So far, however, there has been no evidence to

38. Dobrovatzky, P. E.: Fixation of Alcohol in the Human Cortex and Subcortical Ganglia in Alcoholics, Medicobiological J. (Russian) **5**:117, 1929.

39. von Monakow, C.: Gehirnpathologie, Vienna, Alfred Hölder, 1905.

40. Smith, M. I., and Lillie, R. D.: The Histopathology of Triorthocresyl Phosphate Poisoning, Arch. Neurol. & Psychiat. **26**:976 (Nov.) 1931.

suggest such an associated poisonous agent in the alcoholic encephalopathies that have been occurring in chronic alcoholism, at least from the time of Gudden and Wernicke up to the present, and in all parts of the world.

The fact that the pathologic lesion does not come to a standstill when the alcoholic intake is withdrawn but shows a remarkably progressive tendency, sometimes for weeks or months after the drinking has stopped, with fresh hemorrhages and reactive gliosis and proliferative vascular changes, together with a progressive clinical picture, argues for a secondarily derived toxin, such as might arise from the pathologic state of the alcoholic liver or from disturbed absorption through the atrophic mucosa of the gastro-intestinal tract. These are all involved but fascinating problems open for further work. Frequently in our cases changes were found in the spinal fluid, with a positive globulin reaction and a slight change in the colloidal gold curve, such as 0011211000, with a negative cell count and negative Wassermann reaction. It is reported that a pathologic lipemia is present in alcoholism (Feigl[41] and Bang[42]). Whether this has any connection with the frequently reported lipochrome changes in the nerve cells (Carmichael and Stern[43]), certainly nearly always present, as well as with the frequently occurring corpora amylacea is doubtful. However, the fact that these changes are similar to those found in pellagra, especially in the so-called pseudo-pellagra associated with chronic alcoholism reported by Klauder and Winkelman[8] and Boggs and Padget,[9] raises the question of a possibly associated or secondarily induced avitaminosis, as suggested by Wechsler.[44] In what way these conditions may be related to the lesions of the vegetative centers of the spinal cord and midbrain, as has already been suggested by Orton and Bender[45] in similar conditions, is a problem that we hope to work out in the near future.

If we consider the lesion as marginal, it includes the marginal gliosis of the outer surface and the ependymal gliosis of the ventricles and in both cases is productive and reactive, suggesting an irritative process. The marginal gliosis about the brain stem and spinal cord is usually only a few decimeters in thickness, is invasive and of the astrocytic

41. Feigl: Biochem. Ztschr. **92**:282, 1918; quoted by Wells, H. G.: Chemical Pathology, ed. 4, Philadelphia, W. B. Saunders Company, 1920.

42. Bang: Biochem. Ztschr. **90**:383, 1918; quoted by Wells.[41]

43. Carmichael, N., and Stern, R.: Korsakoff's Syndrome: Its Histopathology, Brain **54**:189, 1931.

44. Wechsler, I.: Communication before the Neurological Section of the New York Academy of Medicine, 1932.

45. Orton, S., and Bender, L.: Lesions in the Lateral Horn of the Spinal Cord in Acrodynia, Pellagra and Pernicious Anemia, Bull. Neurol. Inst. New York **1**:506, 1931.

type. It is prone to follow connective tissue trabeculae. On the surface of the cerebrum the lesion invades the brain along the pial intrusions and also sometimes produces irregularities or hummocks on the outer surface. It is usually limited to the first cortical layer, where the reactive cells are astrocytic in type, but occasionally a cytoplastic gliosis is also seen in the second and third layers, together with swelling of the microglia and oligodendroglia. When the surface of the cerebellum is involved, the lesion is very patchy; there are a glial scarring, with retraction of the outer layer, a loss of Purkinje cells and some invasion of glia cells in the corpuscular layer. Gampers,[1] who studied sixteen brains and reported findings in many ways similar to ours, emphasized the lack of pathologic changes in the cortex. It is true that the cortical nerve cells and deeper layers of the cortex are remarkably free from pathologic disturbances, but the marginal lesions were practically always present in the cases studied by us. The marginal gliosis seems to be the explanation for much of the involvement of the optic nerve, which may be looked on as a narrow evagination of the central nervous system. The lesions concerned in the peripheral neuritis are not explained in the same way and will not be considered in this report. The ependymal reaction is the most marked and characteristic part of the glial pathology. It is both reactive and invasive. It tends to narrow the lumen of the ventricles and aqueduct, and produces an irregular surface with glial hummocks and ependymal pockets. There is also a subependymal wall of gliosis that tends to invade the reticulum. Between the outer ependymal wall and this invasive wall there is a loose mesh of glia fibers containing a coagulable fluid, possibly amylogenous in nature. This somewhat schematically presents the first principle in the localization and type of the lesion which is, briefly, a marginal and ependymal gliosis.

The second principle is probably dependent on the vascular bed which is related to these marginal surfaces. Thus, on the outer surfaces the small invading pial vessels bear the brunt of the lesion. Also in the one cord in this series in which lesions are reported the lesion was found to be directly connected with the distribution of the central branches of the anterior medial spinal vessels which enter the spinal cord through the anterior raphe and immediately terminate about the central part and lateral horn of the spinal gray matter. The invasion of the lesion into the brain stem from the ventricles is also associated with the vascular bed of this region, although its direct connections are not so clear. Whenever there is any lesion deeper in the brain, such as in the thalamic nuclei, it is always by way of the invading blood vessels. In fact, aside from the ependymal and marginal gliosis, the lesion seems to be primarily a vascular one. There is congestion which, in the most acute cases, may be the most general reaction and may extend some distance into the brain tissues. There are characteristically

numerous small hemorrhages about the small vessels, discovery of and emphasis on which led Wernicke to call the condition encephalitis haemorrhagica superior. There are also conspicuous capillary budding and vascular organization, and proliferative changes in the vessels involving both the endothelial and adventitial layers of the vessel walls. Marked regressive changes in the blood vessels were not found by us, although they have been remarked by others (Bouman of Utrecht,[46] Ohkuma [2] and Spielmeyer [47]). The vascular lesions have the same distribution as the glial ones in general, but invade more deeply. To some extent they are found on all surfaces of the central nervous system—the cerebrum, cerebellum, brain stem, optic nerve and even the retina—but they are most marked within the brain stem along the ventricles. The vascular changes and the marginal and ependymal gliosis are apparently not directly dependent on each other, because in the more chronic cases the gliosis may occur without much vascular reaction, as in cases 12 and 16, while in the more acute cases the vascular reaction may predominate, as in cases 1, 2 and 10; in case 3 there is still another type of reaction, shown by a specific gliosis characterized by a greater reaction of the interstitial glia cells, both astrocytic and cytoplastic, with some areas of actual destruction of tissue but without much vascular disturbance. The localization of the interstitial gliosis, however, is the same as the vascular lesion in the other cases.

This brings us to the last principle underlying the distribution of the lesion and that is a tendency toward a specific electivity for gray masses and especially for the the vegetative gray masses that surround the ventricles. All the white areas of the brain or the myelinated tracts, with the exception of the optic nerve, are remarkably free from lesions. Even in the pontile region, where the vascular disturbance invades the reticular formation, it tends to stop short at the white tracts, such as the fasciculus longitudinalis posterior, almost as if the myelinated tracts presented a barrier to the progress of the invasion. This is a contradiction to the long accepted belief that the myelin sheaths are particularly vulnerable to alcoholic intoxication. The subcortical layers are never involved. But for that matter the cortical gray layers show a relative immunity to the disease as compared with the vegetative gray areas of the ventricular system, for which the lesion appears to have a high grade of selectivity. Many investigators (Wernicke, Oppenheim, Gampers, Ohkuma and Neuberger) have recognized this, but none has sufficiently recognized all the conclusions that may be drawn from these findings. The most severe lesions are found in the floor of the fourth

46. Bouman, L.: Hemorrhage of the Brain, Arch. Neurol. & Psychiat. **25**:255 (Feb.) 1931.

47. Spielmeyer, W.: Histopathologie des Nervensystems, Berlin, Julius Springer, 1922; in Bumke, O.: Handbuch der Geisteskrankheiten, Berlin, Julius Springer, 1930, vol. 11.

ventricle, including the nuclei of the eighth to the twelfth nerves, and in the periaqueductal gray masses, including the nuclei of the ocular muscles, and finally in the floor and walls of the third ventricles, including the various vegetative nuclei of the thalamic and hypothalamic regions. The predilection for the mammillary bodies has been noted by many, but it is probably only the result of the location of these bodies at a vulnerable point at the base of the brain and in the floor of the third ventricle, and furthermore because they have a rich capillary bed. That the lesion invades them from the periphery is seen in case 15, which was the most slowly progressive case in our series; yet the lesion is still limited to the periphery, leaving the center of the bodies free. But in the more severely acute cases, the lesion has fairly well destroyed these bodies and invaded the hypothalamus, and in some cases even the corpus striatum, as in such cases it also invades the corpora quadrigemina and the roof of the fourth ventricle, including the dentate nucleus of the cerebellum. Hiller [48] has called attention to the vascular distribution as the basis for the electivity of the lesions in the central nervous system, and although it obviously plays an important rôle in this condition it does not tell the whole story, just as it does not explain why in different diseases different vascular beds are elected.

Of particular interest is the fact that although the nerve cells nearly always show some slight lipoid changes, as emphasized by Carmichael and Stern [43] and many others, actually the nerve cells and fibers are left remarkably intact, even in regions in which the severe vascular and glial changes occur. It is true, especially in the mammillary bodies, that nerve cells are apparently destroyed by the high degree of vascular organization, but even in this case normal cells may be seen between the budding capillaries. The absence of any inflammatory response is also remarkable.

There still remains the question why there is the difference in extent, at least in the distribution and severity of the anatomic response, with a different clinical picture in persons with apparently similar alcoholic histories. Tsiminakis,[49] who reported three cases and spoke of an alcoholic affinity for certain parts of the central nervous system, nevertheless claimed that there is no correlation between the lesions and the clinical picture. However, our studies show a very close correlation, as has been brought out by the clinical discussions. In summary, we need mention only that three cases which showed the most severe lesions starting on the margin of the brain, brain stem and especially the ventricular system and invading the visceral gray centers, especially in the medulla, midbrain and hypothalamic regions, had before death already

48. Hiller, F.: Electivity of Diseases of the Nervous System, Arch. Neurol. & Psychiat. **20**:145, 1928.

49. Tsiminakis, Y.: Alcohol and the Central Nervous System, Arb. a. d. neurol. Inst. a. d. Wien. Univ. **33**:24, 1931.

been classified together as representing a clinical picture with deep clouding of consciousness and changing rigidities, etc. Furthermore, the case that showed the most striking cerebellar symptoms showed lesions penetrating most deeply into the roof of the ventricular system, including the dentate nucleus, the corpora quadrigemina, etc. Cases discussed under the heading of acute catatonia showed a more or less active and invasive response, consisting mostly of the marginal and ependymal gliosis alone.

Since we do not deal with an inflammatory process, it would be better to substitute the term encephalopathia for encephalitis. One may call the cases described here encephalopathia alcoholica or polioencephalopathia alcoholica. The term haemorrhagica is only appropriate to part of the cases, such as those reported in connection with our group I. We believe that our study gives a clearer understanding of the term "wet brain." At autopsy there was usually subpial edema. It is, of course, in no way characteristic, and a more careful study of the phenomenon is necessary. The histopathologic and anatomic facts, at any rate, fit in with the experimental studies of Howe,[50] which have shown that injections of alcohol into the blood or local applications on the brain produce hemorrhages and edema on the surface of the cortex.

SUMMARY

1. *Cases With Changing Rigidities in the Foreground.*—Among the cases described by Wernicke as polioencephalitis haemorrhagica superior, we have separated a group in which the changing rigidities are in the foreground of the neurologic picture. These rigidities are characterized by their changeability and their tendency to increase when passive movements are performed. They are partially phenomena of resistance, as the psychic phenomena of resistance are inseparable from the neurologic picture. They are often accompanied by athetoid movements, and phenomena of grasping and groping are present with the grasping reflex and the sucking reflex. Positive and negative support reactions are common. Disturbances of speech are often observed. Oculomotor signs and pupillary changes are common, but not essential. Optic atrophy and retinal hemorrhages have been observed. Asynergia is a typical feature. Clouding of consciousness and disturbances in sleep are present in every case. Delirious features may be present. In some cases the clouding of consciousness may fade and leave a mental picture similar to Korsakoff's psychosis. There is marked increase in the reaction to pain. Vegetative disturbances, with emaciation, elevation in temperature, sweating and trophic disturbances in the skin of a pseudopellagrous type, are observed and lead to death in from two days to six months.

50. Howe: Communication before the New York Neurological Society, 1932.

Histopathologic examination shows a lesion of the ventricular gray masses starting from the medulla oblongata, reaching through the third ventricle and involving especially the corpora mamillaria. There is also involvement of the substantia nigra, the subthalamic and thalamic regions and the putamen. There are also lesions in the superficial layers of the cortex. The lesions are characterized by hemorrhages, proliferative changes in the small vessels and a marginal glial reaction in which astrocytes prevail. All surfaces of the central nervous system closely connected with the spinal fluid are involved, but more especially where there is a tendency toward stagnation of the fluid. Nuclear areas are more prone to lesions than adjacent myelinated areas, with the exception of the optic nerve. The changing rigidities and similar phenomena, such as athetosis and disturbances in speech, are probably due to lesions of Deiters' nucleus and the adjacent tonus centers, and perhaps to lesions in the region of the hypothalamus, thalamus and striopallidum. But it is also probable that the disturbance in consciousness is a factor. The phenomena of grasping, groping, pointing and sucking have their origin in the medulla, midbrain, striopallidum and cortex, with psychophysical integration playing a part. They can be produced by lesions at various levels. The changes in consciousness and delirious features are due to lesions of the centers of consciousness in the periventricular gray masses extending from the medulla to the third ventricle. The support reaction and the asynergia are due to lesions in the cerebellum, but lesions of the tonus apparatus may also play some part. The increase in the reaction to pain is due to disturbances in the centers of consciousness, but there are also more direct brain stem factors involved. There is a possibility that some of the vegetative symptoms are secondary to changes in the vegetative centers in the ventricular gray areas. There are also unquestionably somatic disturbances in metabolism.

2. *Cases With Cerebellar Symptomatology.*—Among the cases of encephalopathia alcoholica there was a group in which the cerebellar symptomatology was in the foreground of the picture. Two of these cases showed marked oculomotor signs, and the reaction to caloric stimulation of the ears was impaired in both cases. Rigidities were not conspicuous, as in the former group, and the clouding of consciousness was less severe. Histopathologic examination in one case showed less severe vascular disturbances than in the other group, but the lesion had penetrated more deeply into the roof of the ventricles and aqueduct, invading the dentate nucleus of the cerebellum. The anatomic findings offer a possibility of interpreting the Argyll Robertson pupil and the double conjugate palsy observed in one case.

3. *Cases Resembling Acute Catatonia.*—In this group the symptomatology is chiefly that of an acute catatonic picture. In the psychic picture, dissociation and hallucinations are prevalent. Clouding of con-

sciousness plays a less important part. Rigidities are closely associated with resistance of a psychic type. Athetoid movements of a partially psychic character are present. Grasping and groping, and especially pointing, are common. Asynergia is observed, but is partially influenced by tensions and psychomotor activity. In the histopathologic picture a glial reaction is most prominent, with some indication of a more widespread toxic disturbance in the cortex. The theoretical interest in these cases lies in the fact that they link some of the psychomotor signs of catatonia with the rigidities which are due to localized lesions of the type described in group I. The jerky movements are probably an expression of an irritation of the tonic apparatus, which is also responsible for the changing rigidities.

4. *Prolonged Alcoholic Delirium.*—In one case there were observed asynergia, tensions of varying degrees and support reactions. These symptoms point to an encephalopathia of a mild degree.

5. *Cases of Encephalopathia Combined with a Neuritis.*—Seven cases were studied in which there was a mixture of neuritic and central nervous system signs. The cerebral symptomatology may dominate the picture and the neuritis may be indicated only by the painfulness of the deeper tissues, or at the opposite extreme there may be only nystagmus and slight ocular signs to suggest lesions of the central nervous system associated with a marked polyneuritis. Signs of a lesion of the pyramidal tract may be present. In the majority of cases there was a tendency toward queer postures, athetoid movements and even jerky movements. Pseudo-pellagrous changes in the skin were present in three cases. Clouding of consciousness, when present, was usually of minor degree, but all variations to a typical Korsakoff picture may be observed. One case showed no psychic changes during most of the period of observation. Chronic progressive glial changes, with the same localization as in the other groups, were found in one case. Although none of the patients in the first three groups survived, two of those whose cases were reported in this group recovered. In these two cases the signs of disturbances in the central nervous system were not marked.

6. *Problem Cases.*—Three problem cases of changes in the central nervous system are discussed: (1) the case of a senile person with alcoholic neuritis associated with peculiar trophic changes in the hands and feet, (2) a picture resembling tabes dorsalis and (3) a picture of unusual midbrain symptomatology. The variety of the neurologic symptomatology of chronic alcoholic intoxication has thus far been underrated.

Neuropathologic Problems.—The lesions always occur in parts of the central nervous system which are adjacent to the spinal fluid and are most severe where the spinal fluid flows least freely, especially in the ventricular system. There is a tendency toward a specific electivity

for gray masses and especially for vegetative gray masses along the ventricles. The data suggest that the spinal fluid carries the noxious agent. The different clinical groups described show a corresponding difference in the anatomic localization and the type of the lesion, so that we are inclined to recognize at least four different groups: (1) cases with a prevalence of changing rigidities, (2) cases with cerebellar features, (3) cases resembling acute catatonia and (4) cases associated with polyneuritis. Since the lesion is not inflammatory or primarily hemorrhagic, but is characterized by a marginal and ependymal invasive and productive gliosis with an underlying proliferative vascular lesion, we suggest the name encephalopathia alcoholica instead of the classic name polioencephalitis haemorrhagica superior of Wernicke.

DISCUSSION

Dr. Paul Schilder, New York: The muscular rigidity in these cases is characteristic, and corresponds in a clear way with the psychic phenomena of resistance; so here is a point on which the psychiatrist and the neurologist have a common ground. This is clearly marked in the first group of cases, but it comes out even more strongly in the third group, in which the rigidities have a great similarity to the rigidity of catatonia. It is remarkable that in all the cases there are support reactions (*Stützreaktion*). It also offers theoretical interest that in all of the cases of encephalopathia alcoholica one finds grasping phenomena. Probably all of these phenomena are in connection with the primitive motor centers around the vegetative axis in the ventricular system.

Dr. I. S. Wechsler, New York: The wealth of material which Dr. Bender and Dr. Schilder have presented makes it difficult to comment on this paper, but I wonder whether it is wise to create so many types from a simple pathologic condition. It has always seemed to me a wrong neurologic principle to do that. The same error holds in epidemic encephalitis, many of the syndromes of which parallel those presented in this paper. It is well known that it is not so much the pathologic process or the causative agent which is responsible for the syndromes as the anatomicophysiologic structures.

As to the statement that the pathologic changes near the surface are due to toxins circulating in the spinal fluid, it is not altogether proved that noxious agents can bring them about; in fact, it is commonly believed that Held's membrane ordinarily prevents the passage of poisons from the fluid to the brain.

What interested me greatly is the use of the term encephalopathia alcoholica rather than encephalitis. It is evident that we are not dealing here with an inflammatory process, but rather with a degenerative one. The views of the authors fits in with those which I have held for some time, and corroborate in a measure my conception of alcoholic and other neuritides as toxic degenerative states on the basis of avitaminosis.

PARTIAL AGENESIS OF THE CORPUS CALLOSUM

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The apparent rarity of agenesis of the corpus callosum is indicated when one considers that a review of the literature to the present time reveals only eighty-one cases. We add in the present paper a study of a brain with partial agenesis, bringing the number of cases to eighty-two.

The earliest record of a case is that of Reil,[1] who described a brain with complete agenesis of the corpus callosum in a stupid woman, 30 years of age. In 1922, Mingazzini [2] summarized completely the work on agenesis of the corpus callosum, eliminating cases of atrophy and classifying the degrees of defect. His analysis indicated that there were seventy-one reported cases of agenesis of the corpus callosum, forty-three showing complete agenesis and twenty-eight showing only partial agenesis. However, three cases before 1922 were not included in Mingazzini's monograph. Two of these (those of Drossaers [3] and Hultkrantz [4]) were mentioned in the work of de Lange,[5] and the other is that of Cameron and Nicholls.[6] Since 1922, seven descriptions have been reported, six of complete agenesis and one of partial agenesis. Of all of the eighty-two cases, only two have been reported in the United States. Archambault,[7] in 1911, reported a case of complete agenesis, and we report one of partial agenesis in the present paper.

From the Department of Anatomy, Ohio State University.

1. Reil, J. C.: Mangel des mittleren und freien Theils des Balkens im Menschengehirn, Arch. f. d. Physiol. **11**:341, 1812.

2. Mingazzini, G.: Der Balken: Eine anatomische, physio-pathologische und klinische Studie, Berlin, Julius Springer, 1922.

3. Drossaers, J. G.: Academisch Proefschrift, Amsterdam, 1913.

4. Hultkrantz, J. V.: Ueber die Hirnfunktionen bei Agenesis des Balkens, Uppsala läkaref. förh. **26**:1 (Sept.) 1921.

5. de Lange, C.: On Brains with Total and Partial Lack of the Corpus Callosum and on the Nature of the Longitudinal Callosal Bundle, J. Nerv. & Ment. Dis. **62**:449, 1925.

6. Cameron and Nicholls: Two Rare Abnormalities Occurring in the Same Subject: Partial Absence of the Corpus Callosum; the Stomach Situated Entirely Within the Thorax, Canad. M. A. J. **11**:448, 1921.

7. Archambault, La S.: A Contribution to the Anatomy and Pathogeny of Agenesia of the Corpus Callosum, Albany M. Ann. **32**:513 and 561, 1911.

A short résumé of each of the cases since Mingazzini's work is as follows:

HULTKRANTZ.[4]—*Complete agenesis.*

A man, a farm servant, aged 21, died of sepsis from a carbuncle. The father was a soldier; the mother was normal. The patient walked at 2 and talked at 4 years. The corpus callosum was absent, as was the septum pellucidum. There was a radial arrangement of the sulci on the medial surface of the brain. The fissura sylvii gaped so that the pole of the insula could be seen. There was no hydrocephalus; the posterior horns were widened. The anterior commissure measured 3 mm. in diameter. The fornix was normal.

CAMERON and NICHOLLS.[6]—*Partial agenesis.*

A girl, an idiot, aged 15, was well developed physically. Her conversation was of a childish type. She answered questions in monosyllables, which were followed by a grin. The falx cerebri existed only as the anterior and posterior ends. There was absence of the corpus callosum one-half inch (1.2 cm.) posterior to the genu. The septum pellucidum was absent. The fornix was normal. The posterior horns of the lateral ventricles were enlarged. The rolandic fissure was divided into upper and lower segments (embryonic arrangement). The parieto-occipital fissure was farther posterior than is usual.

MEYER.[8]—*Complete agenesis.*

A Swedish man, aged 40, a ship's officer, died suddenly; no diagnosis was made. Absence of the corpus callosum and septum pellucidum was noted. There was a massive hydrocephalus. The fornix was normal.

DE LANGE.[5]—*Complete agenesis.*

A boy, aged 5 months, died of pneumonia. He was the fifth child of healthy parents. Nervous diseases were reported in the mother's family. The boy was born in asphyxia, and did not increase in weight. In appearance he resembled a cretin. Inspiration was difficult. The forehead was narrow and retreating. There was absence of the corpus callosum and septum pellucidum. The fornices remained separated. The gyrus cinguli and fissura callosomarginalis were repeatedly separated by radial sulci. The calcarine fissure did not meet the parieto-occipital fissure. The olfactory bulbs and nerves were lacking. Other anomalies of the lateral brain surface were present, including polygyria.

DE CRINIS.[9]—*Complete agenesis.*

The patient was an infant, aged 2 weeks, born by a normal delivery. No history was available. The brain was malformed and pathologic. There was a meningocele from both glabellae. Both hemispheres were asymmetrical, and the outer form was greatly changed. The principal gyri on the lateral and medial surfaces were scarcely recognizable. The lobus paracentralis, praecuneus and cuneus were not separated from each other. Gyri in the temporal region were not separated. There was absence of the corpus callosum.

BERTRAND and HADZIGEORGIOU.[10]—*Complete agenesis.*

No clinical history is available. There was absence of the corpus callosum. The anterior commissure was twice the normal size. There was an enormous

8. Meyer, O.: Kompletter Balkenmangel, Centralbl. f. allg. Path. u. path. Anat. **35**:267, 1924-1925.

9. de Crinis, M.: Case of Absence of the Corpus Callosum, J. f. Psychol. u. Neurol. **37**:443, 1928.

10. Bertrand and Hadzigeorgiou: Etude anatomique d'un cas d'agénésie du corps calleux, Rev. neurol. **1**:72, 1929.

enlargement of the posterior horn of the lateral ventricle. There was also a hypertrophic cerebral sclerosis.

GUTTMANN.[11]—*Complete agenesis.*

A boy, aged 5, died with epileptic seizures of the right side. He was left-handed. He answered questions normally. There was absence of the corpus callosum and septum pellucidum. The calcarine fissure did not meet the parieto-occipital fissure. The left hemisphere was smaller than the right. There were microgyri in the parieto-occipital region. There was deformity of the anterior horns of the lateral ventricles; the posterior horns were enlarged. The vermis was deformed, the fourth ventricle being flat. The fornix was normal.

HAYEK.[12]—*Partial agenesis.*

The patient was newly born. The brain was normal in size. The important gyri and sulci were normally developed. The corpus callosum was one-half the normal length, corresponding to an embryo of 125 mm. The splenium was present but was very thin and underdeveloped. The septum pellucidum was present. The calcarine fissure joined the parieto-occipital fissure. There was partial development of the sulcus cinguli (anterior and middle parts). The fornix and cortical surface were normal.

HINRICHS.[13]—*Complete agenesis.*

A child, aged 4 months, died of bronchopneumonia. The mentality was not determined. The father had committed suicide. There was absence of the corpus callosum and septum pellucidum. No longitudinal sulcus was present in the frontal region. There was absence of the commissural fibers of the fornix. Hydrocephalus was marked. The description given is principally microscopic.

Two recent papers, the titles of which indicate agenesis of the corpus callosum, prove to be inappropriately named or the condition was pathologic. We refer to the case of Thomas,[14] which showed primarily a bifurcation of the caudal end of the corpus callosum and not a congenital absence, as the title of the paper would suggest, and the case of Huddleson,[15] which was of pathologic origin due to the pressure of a lipoma in the corpus callosum. Huddleson gave an excellent review of the literature of lipomas of the corpus callosum.

De Lange [5] has presented the most recent complete description of the gross and microscopic findings in complete agenesis of the corpus callosum, with a discussion of the possible theories of origin.

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11. Guttmann, L.: Ueber einen Fall von Entwicklungsstörung des Gross- und Kleinhirns mit Balkenmangel, Psychiat.-neurol. Wchnschr. **31**:453, 1929.

12. Hayek, H.: Ueber einen Fall von Hypoplasie des Balkens an einen in situ geharteten Gehirn eines Neugeborenen, Virchows Arch. f. path. Anat. **273**:767, 1929.

13. Hinrichs, U.: Ueber eine durch Balken- und Fornixmangel ausgezeichnete Gehirnmissbildung, Arch. f. Psychiat. **89**:57, 1929.

14. Thomas, L.: Case of Absence of the Corpus Callosum in a Human Brain, Arch. d'anat., d'histol. et d'embryol. **10**:347, 1929.

15. Huddleson, J. H.: Absence of the Corpus Callosum, with Lipoma Formation in the Defect, Ztschr. f. d. ges. Neurol. u. Psychiat. **113**:177, 1928.

HISTORY OF AUTHORS' CASE

History.—K. J., a colored boy, was born on Oct. 15, 1913. The mother was immoral, a drunkard and a morphine addict; the paternity was not definitely established. The boy was removed from the mother when a baby because the home was considered unfit. K.'s early physical development was normal; however, his mental development was seriously retarded. As a result, he failed to make regular progress in school and became a behavior problem for the teacher. His interest in

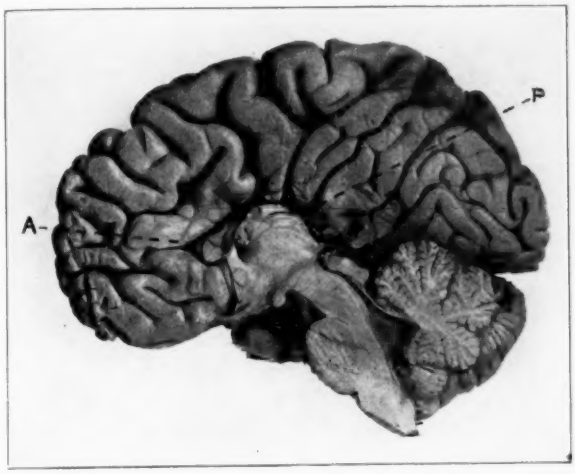

Fig. 1.—Medial surface of the right hemisphere with the pia removed. The line *AP* represents the cuts necessary to display the parts illustrated in figure 2.

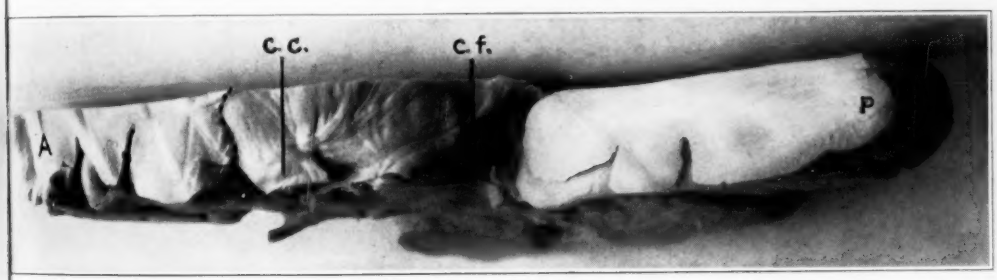

Fig. 2.—Dorsal surface of the roof of the right lateral ventricle (between cut surfaces of the hemisphere). See figure 1 for method of section. This photograph shows the radiation from the callosal commissure: *c.c.*, corpus callosum; *c.f.*, column of fornix.

any phase of school work was entirely lacking, and this resulted in serious difficulties. He could write, but could not spell his name; he was unable to solve the simplest problems in arithmetic. He was not able to make a social adjustment in any of the homes in which he was placed. He was also a habitual runaway, but did not give reasons for doing so. His rationalizations were of the feebleminded type.

At 14½ years, K. was brought into the juvenile court. According to psychologic tests, made at that time by the Bureau of Juvenile Research, K. had a verbal intelligence of 10 years (intelligence quotient, 69) with the Stanford-Binet test, 11 years with the Ohio literacy test and 8.5 years with the Morgan test. His manual intelligence was 9 years with the Healy pictorial completion board no. 1. With the Healy board no. 2 he failed to score. He rated 11 years with the Witmer form board, and 14 years with the Knox imitation test.

In physical development, K. was above the average for boys of his age. His average physical and psychomotor measurements were 83 and 75, respectively, with a negative psychomotor excess of 8. Physical examination, at 14½ years, indicated that he was in fair condition, although slightly underweight. No sensory defects were noted. Clinical examination at this time showed a normal urine and negative Wassermann and Kahn tests.

K.'s conduct at the Bureau of Juvenile Research was fairly good. He did not attempt to run away, but threatened to do so. At the end of his stay at the Bureau, the following recommendations were made: "This boy's past behavior, together

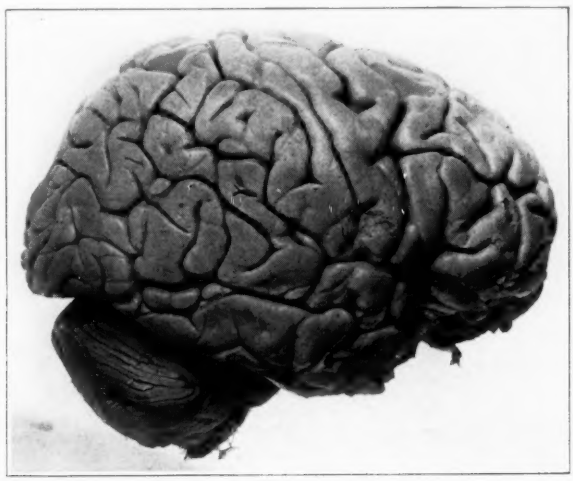

Fig. 3.—Lateral surface of the right hemisphere with the pia removed.

with his low mentality, leads us to believe that he will not make a satisfactory social adjustment at this time if placed in another home. He is unstable and mentally incapable of assuming the responsibilities of society. We recommend that he be committed to the Institution for the Feeble-Minded."

K. was admitted to the institution for the feebleminded in 1928. His stay there was uneventful, except for a runaway lasting four days. He died on Feb. 23, 1930, of pulmonary tuberculosis, being at that time 17 years of age.

Description of Brain.—The brain presented a partial agenesis of the corpus callosum. It showed the earliest stage of the development of the corpus callosum, after the formation of the septum pellucidum, and characteristically indicated that the fibers of the corpus callosum are derived from the whole of the cerebral cortex, even in its earliest stages. Correlated with this anterior development of the corpus callosum was the change anteriorly of the early embryonic radial arrangement of the transverse sulci into the later fetal form, here represented by the anterior and middle callosomarginal sulci. The radial arrangement was still maintained posteriorly.

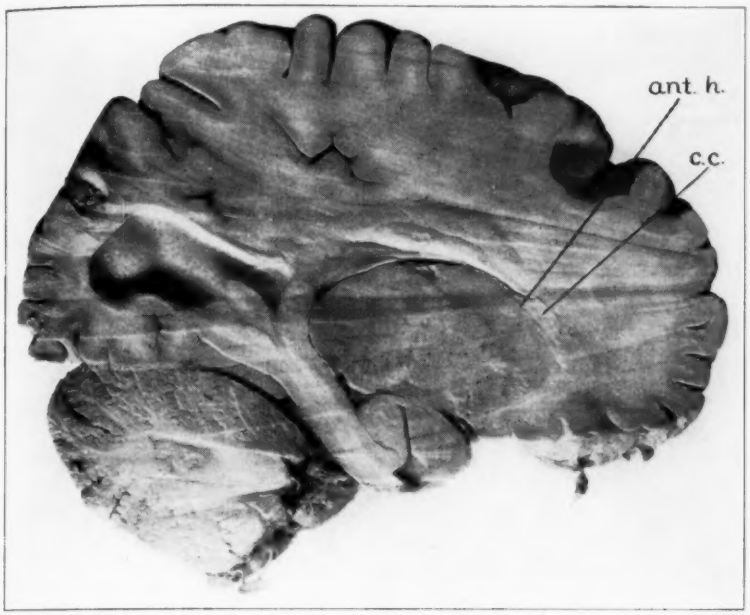

Fig. 4.—Lateral surface of a section (one-half inch thick) of the right hemisphere, made one-half inch lateral to the medial surface of the hemisphere: *ant.h.*, anterior horn; *c.c.*, corpus callosum.

Fig. 5.—Lateral surface of a section (one-fourth inch thick) of the right hemisphere. The surface pictured is 1 inch (2.5 cm.) lateral to the medial surface of the hemisphere.

In describing the brain there will be mentioned only such changes from the normal as were outstanding; the photographs will add further details.

Right Mesial Surface: The cortical substance on the medial surface of the right hemisphere (fig. 1) presented anomalies, some characteristic of agenesis of the corpus callosum and others not related to this condition. Among the unrelated anomalies may be mentioned the polygyric condition of the frontal pole and of the occipital region. Owing to the partial agenesis of the corpus callosum there was a combination of anomalies, some characteristic of total agenesis and some more closely associated with the partial agenesis. Anteriorly, where the corpus callosum was represented by a comma-shaped commissure, the radial arrangement of the transverse sulci was lost. In their place, the anterior and middle callosomarginal sulci had developed, which represented a condition not far removed from the adult form. Posteriorly, where there was no corpus callosum, the sulci were radially connected with the callosal sulcus.

In the parieto-occipital region, the nonunion of the calcarine and parieto-occipital sulci was typical of agenesis of the corpus callosum. The calcarine sulcus

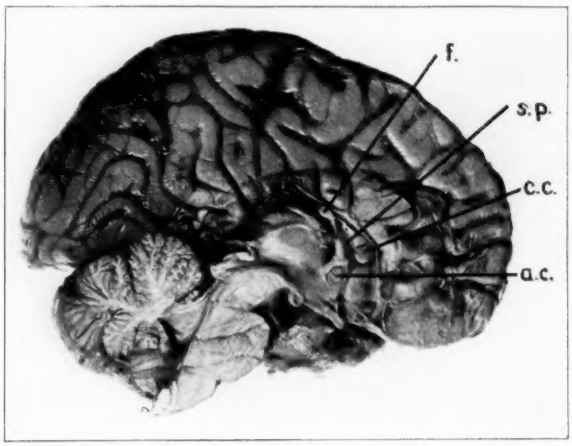

Fig. 6.—Medial surface of the left hemisphere with the pia and blood vessels present: *a.c.*, anterior commissure; *c.c.*, corpus callosum; *f.*, fornix; *s.p.*, septum pellucidum.

extended anteriorly to a point immediately behind the parieto-occipital fissure, where it turned and pursued a course parallel to the latter.

The cut surface of the medial view of the right side showed the partially developed corpus callosum. It was comma-shaped and located anterior to the anterior commissure, between the para-olfactory area and the gyrus fornicatus. When the callosal sulcus was separated just above the corpus callosum, a distinct fanlike radiation of callosal fibers (fig. 2) could be seen, extending in the roof of the lateral ventricle from the point of crossing to all parts of the hemisphere. These radiations could be traced for a short distance in the sagittal sections of the hemisphere. A great many of these callosal fibers seemed to come from the posterior tip of the comma-shaped area. In addition, fibers could be noted extending from the column of the fornix and disappearing among the fanlike callosal radiations, probably from the gyrus fornicatus. (This suggests the complex nature of

the callosal commissure.) Below the corpus callosum, the anterior commissure was seen; it measured 3 by 5 mm., which is within the bounds of normalcy. From the third ventricle, the foramen of Monro appeared somewhat larger than normal.

Right Lateral Surface: The lateral surface of the hemisphere (fig. 3) was characterized by polygyri in the parietal and occipital regions and the frontal pole. The only other deviation from the normal was the marked narrowness of the postcentral gyrus.

Right Basal Surface: The inferior surface of the hemisphere appeared normal in all respects. An inspection of the pia with its vessels revealed a normal blood supply. Inspection of the points of origin of the cranial nerves indicated no anomalies.

Right Lateral Ventricle: The surface of the ventricle was smooth, except in the posterior horn where it was slightly roughened (fig. 4), although not giving the appearance of inflammation. The anterior horn (fig. 4, *ant.h.*) was almost completely absent, and was faintly represented by a narrow slit, nearly obliterated by the close approximation of the fibers of the corpus callosum and the corpus striatum. The posterior horn was enlarged, being 17 mm. or more in diameter (fig. 5). The inferior horn appeared to be of normal size (fig. 5).

Left Half of Brain: The left half of the brain presented no marked differences from the right half. Perhaps the only structure that was shown in the left half and not in the right was the septum pellucidum (fig. 6, *s.p.*), which was removed on the right side.

COMMENT

Age.—The majority of cases of agenesis have been discovered at autopsy in persons in the first decade of life. Others have been encountered in the second, third and fourth decades. At the upper limit are two cases, one discovered at 72 years of age (Poterin-Dumotel [16]) and the other at 73 years (Banchi [17]).

Mentality and Function.—The intellectual status of patients who were sufficiently old to permit a decision ranges from idiocy to mediocrity. There were no high types of mentality. Those who lived to an older age were as a rule of mediocre intelligence. In those with a mediocre intellect, the ability to read and write does not seem to have been impaired. In fact, the case histories of patients with agenesis rarely suggest the function of the corpus callosum, for the other anomalies of the brain so becloud the picture as to leave little that might be explained by its absence. In 1921, Cameron and Nicholls [6] stated in regard to the mental status of patients with agenesis of the corpus callosum:

> . . . such meagre evidence as we possess seems to indicate that the callosal fibers are of more importance in maintaining and governing the finer co-ordinations of muscular movement in the limbs of the opposite sides than in regulating the

16. Poterin-Dumotel: Gaz. d. hôp. **36**:47, 1863.

17. Banchi, A.: Studio anatomico di un cervello senza corpo calloso, Arch. ital. di anat. e di embriol. **3**:658, 1904.

higher function of mentality. Thus apraxia of the homolateral hand has been shown to occur when there is an interruption of impulses which pass from the left cortex through the corpus callosum to the right cortex.

More recently, Lafora and Prados [18] performed some experiments with monkeys, which demonstrated that section of the corpus callosum is followed by a paralysis of the "upper or lower feet," this depending on the location of the section, i. e., the anterior or the posterior part. Besides, both right and left section is followed by a series of phenomena identical with those of crossed hemiplegia.

A later work on the function of the corpus callosum is that of Seletzky and Gilula.[19] They carefully reviewed the literature of experimental work on the corpus callosum. Their own work with rabbits and dogs may be summarized as follows: Section of the hind part of the corpus callosum causes little disturbance except a slight ataxia of the extremities. Section of the anterior or middle part of the corpus callosum results in a disturbance of sensibility, sometimes in all extremities, sometimes in only a few, and then again in the body or trunk. The gait is disturbed, being ataxic. The sense organs on the side of the section are disturbed, resulting in a loss of hearing, sight, taste or smell perceptivity. Occasionally there is a tendency for the rabbits and dogs to move in circles. All the previously described symptoms disappear after a longer or shorter time, and the animal shows no more abnormalities. The last-mentioned fact has been overlooked by many authors.

In an attempt to correlate function with structure, we quote the following from Seletzky and Gilula: [20]

> Erhaben wir nun Schluss die Frage danach, auf welche Weise alle diese beim Balkenschnitt von uns beobachteten Symptome zu erklären sind, so lasst sich folgendes sagen (zitiert nach Mingazzini):
>
> Man unterscheidet im Corpus callosum innere, mittlere, und untere Fasern. Die inneren Fasern entspringen aus dem Gyrus fornic., der inneren oberen Flache des Gyrus frontalis primus, dem oberen Drittel der Rolandischen Windung, sowie den Lob. paracentralis et parietalis superior. Die mittleren Fasern kommen aus der äusseren oberen Flache der Grosshirnhemisphäre, hauptsachlich aus dem unteren Stirnlappen und zum Teil aus dem mittleren Teil der Rolandischen Windung, dem Lob. parietalis inferior. Somit kann eine Durchschneidung der inneren und mittleren Schicht eine gewisse Gangstörung nach sich ziehen (Durchschneidung der Fasern aus den zentralen und parietalen Windungen), sowie Alterationen seitens der Psyche: Apathie, Mangel an Beweglichkeit und dergleichen. Die Fasern der unteren Schicht entstammen dem Gyrus operculi, sowie den hinteren

18. Lafora and Prados: Investigaciones experimentales sobre la funcion del cuerpo calloso, Siglo méd. **69**:169, 1922.

19. Seletzky and Gilula: Zur Frage der Funktionen des Balkens bei Tieren, Arch. f. Psychiat. **86**:57, 1928.

20. Seletzky and Gilula,[19] p. 71.

Teilen des 1. und 2.Schlafenlappens und zum Teil der Insula Reilii, hieraus resultieren Störungen des Geschmaks, der Gehörsempfindungen und dergleichen.

[In drawing conclusions regarding the manner in which are to be explained the symptoms that we have observed after section of the corpus callosum, it may be said (quoting from Mingazzini):

One differentiates in the corpus callosum internal, mesial and inferior fibers. The internal fibers arise from the gyrus fornicatus, the supero-internal surface of the gyrus frontalis, the upper third of the rolandic convolution and the paracentral and superior parietal gyri. The mesial fibers come from the supero-external surface of the cerebral hemisphere, chiefly from the lower frontal lobes, and in part from the middle third of the rolandic convolution and the inferior parietal lobule. Hence, a section through the internal and mesial layers may produce a disturbance in gait (interruption of the fibers from the frontal and parietal convolutions), together with psychic alterations: apathy, diminished motility and the like. The fibers of the lower layer arise from the gyrus operculi, and also from the posterior portions of the first and second temporal convolutions and in part from the island of Reil, whence there result disturbances in taste, hearing and the like.]

In 1931, Alpers and Grant[21] presented the clinical syndrome of the corpus callosum in the human brain. Their study of a series of five cases of tumor of the corpus callosum indicates that an inability to concentrate and maintain attention, motor signs (hemiparesis or weakness of all four limbs) and apraxia are the outstanding symptoms. These symptoms correspond closely with those observed in experimental work on animals. However, in the experimental animals of Seletzky and Gilula,[19] the symptoms disappeared in time. It is interesting to note here that these same symptoms do not seem to be present in cases of agenesis.

Associated Bodily Anomalies.—In association with agenesis of the corpus callosum, only four cases of bodily defect are recorded: cleft palate and harelip,[22] heterotopia of the brain substance, cryptorchidism and malposition of the stomach high in the thorax.[6] Physical development is usually above average in patients with absence of the corpus callosum.

Etiology.—The question as to the cause of the absence of the corpus callosum is hardly beyond the realm of guesswork. A cause for complete agenesis must have started or been in progress by the third fetal month, as this is the time when differentiation of the corpus callosum occurs. Among the suggested factors in the different cases were: developmental defect, ependymitis with hydrocephalus internus, syphilis and chemical toxins.

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21. Alpers, B. J., and Grant, F. C.: The Clinical Syndrome of the Corpus Callosum, Arch. Neurol. & Psychiat. **25**:67 (Jan.) 1931.

22. Anton, G.: Die Bedeutung des Balkenmangels für das Grosshirn, Verhandl. d. Gesellsch. deutsch. Naturf. u. Aerzte **68**:318, 1897.

PECULIARITIES OF BRAINS WITH AGENESIS OF THE CORPUS CALLOSUM

Almost constantly associated with agenesis of the corpus callosum are certain other anomalies of the brain:

1. The one most frequently encountered is dilatation of the posterior horns of the lateral ventricles. Correlated with this dilatation is a thinning of the walls of the posterior horns.

2. The two principal sulci of the posterior part of the medial surface, the calcarine and the parieto-occipital, are prevented from joining by an interposed superficial gyrus.

3. The sulci on the mesial aspect of the cerebral hemispheres possess a radiating arrangement. In brains with only partial agenesis of the corpus callosum, this radial arrangement is modified, especially adjacent to the corpus callosum. Here the beginning of the sulcus cinguli is represented by the anterior, middle or posterior callosomarginal sulci. This development is characteristic of the fetus at the end of the sixth month.

4. Total agenesis of the corpus callosum is associated with absence of the septum pellucidum. This septum, with the cavum of the septum pellucidum, is present in cases of partial absence of the corpus callosum.

5. The hippocampal commissure is usually absent in total agenesis of the corpus callosum, although the body and the columns are normal.

6. All cases on record, with the possible exception of Banchi's[17] case, are associated with at least one other anomaly of the brain not already mentioned, such as polygyria, absence of olfactory nerves, incomplete separation of the frontal lobes, hydrocephalus and an enlarged anterior commissure.

SUMMARY

1. A case of partial agenesis of the corpus callosum is reported, with a review of the literature. Constant peculiarities of the brain in cases of agenesis of the corpus callosum are summarized.

2. Since 1812, eighty-two cases of agenesis of the corpus callosum have been reported, in fifty-one (62 per cent) of which it was complete and in thirty-one (38 per cent) partial.

3. Agenesis of the corpus callosum is usually associated with other anomalies of the brain, such as polygyria, embryonic arrangement of sulci, absence of olfactory nerves and partial separation of the frontal lobes.

4. The age of distribution of agenesis ranges from birth to 73 years of age, the majority of patients being in the first decade of life.

5. The mentality of the patients varies from idiocy to mediocre intelligence, corresponding somewhat with the associated anomalies of the brain.

6. The etiology of this condition is unknown, although many speculations have been suggested.

7. The function of the corpus callosum, as determined from a study of the cases of agenesis and recent experimental research, is embodied within the paper.

PATHOLOGY OF CENTRAL NERVOUS SYSTEM IN DISEASES OF THE LIVER

EXPERIMENTS WITH ANIMALS AND HUMAN MATERIAL

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At different periods the problem of the direct relationship between diseases of the liver and those of the brain has been prominent in clinical neurology. In the nineties of the last century, Leyden taught his idea of hepatogenous intoxication of the central nervous system. The French school of this time tried to give an experimental basis to these theories by injecting bile salts into animals and studying the toxic manifestations that followed. Under the leadership of Quincke, Hoppe-Seyler and Krehl, however, opposition arose against such a conception of "cholemia." They thought that a direct overflow of normal bile products was not responsible for the nervous disorders, but that the rôle of the liver as a detoxicator was severely disturbed. Accumulation of intermediary products of protein and carbohydrate metabolism in the blood was thought to be the primary etiologic factor.

Interest in the relationship between the function of the liver and the central nervous system was again aroused when Wilson, 1912, described the simultaneous occurrence of cirrhosis of the liver and lenticular degeneration as a familial disease. Economo and Schilder, in 1920, suggested a close relationship between this disease and similar cases described by Homen and Anton and the pseudosclerosis of Westphal and Struempell. Spielmeyer, in 1920, finally pointed out the close histopathologic similarity of these different clinical syndromes. In the more recent literature many instances are reported in which diseases of the liver preceded nervous manifestations, which were minor variations of these different groups and which at autopsy showed a similar pathologic condition of the striatum typified by the status spongiosus, the formation of Alzheimer's glia cells and the proliferation of blood vessels in the older foci. Cases of a parkinsonian-like syn-

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drome or clinical manifestations which simulated encephalitis have been described under similar pathologic conditions. In rare instances the pseudosclerosis was associated with subacute combined degeneration of the spinal cord.

In the discussion of the etiology following the presentation of these cases one will find one of the following theories advanced: 1. The hepatic disease is the primary factor; an endogenous toxin is formed which acts secondarily on the nerve tissue (Wilson, Pollack). 2. Diseases of the liver and of the brain are simultaneous manifestations of an endogenous toxin formed outside the liver (Goldstein). 3. Diseases of the liver and of the brain are the simultaneous expression of congenital deficiencies of these organs (Bielschowsky and Henneberg; the formation of the giant glia elements is here suggested to be a blastomatous process). 4. The primary factor is the disease of the central ganglia which regulate the circulation of the liver, this disease producing functional disturbances in this organ (Oberling and Kalbo: "angioneurotic disease of the liver").[1]

Experimentation on animals allows a better study of the interrelationship between liver and brain than does pathologic conditions in the man. Until the present time, experimental research has been concerned with two problems: Whether or not different diseases of the liver produce specific effects, and whether or not there is a specific localization of the pathologic process in the brain. Most authors agree that the character of the hepatic disease neither influences the histopathologic picture nor determines the localization within specific nuclei. Severe degenerative changes of nerve cells, accompanied by mild glial proliferation, are described. It seems, according to Okada,[2] that the first histologic changes can be detected in rabbits approximately on the sixth day following damage to the liver.

The present investigation was stimulated by an observation by Crandall and Cherry[3] on patients suffering from hepatic disease. They found a marked increase of oil-splitting lipase in the serum. The same phenomenon was found in patients suffering from multiple sclerosis. Brickner had described in the latter condition an increase in lecithinase, and concluded that there was a direct relationship between the lipolytic activity and the destructive effect of the plasma of these

1. Most of the literature on this subject is collected in the following two reviews: Neustadt, R.: Nervenarzt **2**:34, 96 and 158, 1929; Loevy, H.: ibid. **4**:653, 1931.

2. Okada, S.: Okayama-Igakkai-Zasshi **43**:813, 1931.

3. Crandall, L. A., and Cherry, I. S.: Arch. Neurol. & Psychiat. **27**:373 (Feb.) 1932.

patients on the spinal cord of rats in test tube experiments.[4] The theoretical basis of such possibilities has been discussed by one of us (Weil [5]).

Three questions were to be answered by our experiments: 1. Is it possible to demonstrate in the serums of experimental animals, after hepatic damage, substances which act destructively on the spinal cord of rats in test tube experiments? 2. Is abnormal ferment activity responsible for such destruction if it is found? 3. Do the histopathologic pictures of the brain under different experimental conditions and in different animals resemble those described in former investigations?

METHODS

Hepatic damage was produced in dogs by ligation of the common bile ducts and of the pancreatic ducts or by an Eck fistula; in rats, by ligation of the common bile duct. Berg and Zucker have demonstrated recently that ligation of the pancreatic ducts produces a severe fatty degeneration of the liver.[6] Similar changes are found after ligation of the common bile ducts in dogs. In rats the reaction seems to be somewhat milder. Approximately three weeks after the operation, the liver becomes atrophic and yellowish, and presents the histologic picture of a beginning necrosis of the liver cells, without, however, the advanced fatty degeneration seen in the liver of dogs under the same experimental conditions.

The serum of the dogs on which operation had been performed was incubated with the spinal cord of rats before and after the operation, at different intervals (5 cc. of serum with approximately 50 mg. of spinal cord for twenty hours, at 37 C.). After fixation in formaldehyde, the spinal cord was embedded in paraffin, and sections were stained with the rapid method for myelin sheaths (Weil).

RESULTS

Beginning approximately at the fourth day following the operation, the serum produced marked changes in the incubated spinal cords. While the normal serum produced a mild swelling of the myelin sheaths only, the serum of the animals on which operation had been performed produced a marked swelling and fragmentation of the nerve fibers, as seen in sections stained for myelin sheaths and axis cylinders (Davenport's method). There was also a complete demyelinization in the outer zones of the longitudinal sections, which became less marked toward the inner zones (fig. 1). In sections stained with cresyl violet, there were complete absence of glia nuclei in the outer zones and vacuolization or shadow formation of the nerve cells, with granular

4. Brickner, R. M.: Bull. Neurol. Inst., New York **1**:105, 1931.

5. Weil, A., and Cleveland, D. A.: Arch. Neurol. & Psychiat. **27**:375 (Feb.) 1932.

6. Berg, B. N., and Zucker, T. F.: Proc. Soc. Exper. Biol. & Med. **29**:68, 1931.

disintegration of their nuclei. Serum obtained before the operation did not greatly influence the staining qualities of glia nuclei and nerve cells. There were mild swelling and an indistinct staining of the Nissl bodies, but never such severe changes as occurred in the serums of the animals on which operation had been performed.

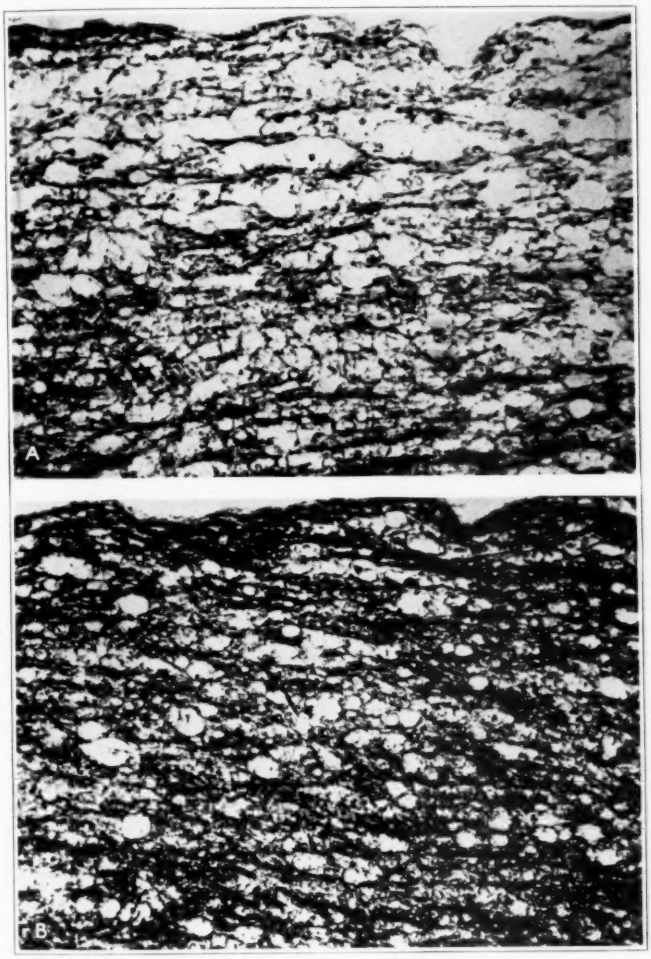

Fig. 1.—*A*, serum of dog B-11 before operation, was incubated with the spinal cord of rats for twenty hours at 37 C. Longitudinal section of spinal cord stained with Weil method for myelin sheaths; it corresponds to H, or 1+, in the table. Leitz obj., 10 mm., ap.; ocul., 10 ×. *B*, serum of dog B-11, seven days after ligation of the common bile duct, was incubated with spinal cord of rats twenty hours at 37 C. Longitudinal section stained with Weil stain; it corresponds to H, or 3+ in table. Magnification same as in *A*.

The accompanying table gives the results of our investigation. It demonstrates that following ligation of the common bile duct the

serum did not produce any marked changes up to the fourth day following the operation. In the later periods there was severe destruction of the spinal cords. Serums of five dogs with ligation of the pancreatic ducts showed similar results.

The values for olive oil-splitting lipase are added to this table. The numbers indicate how many cubic centimeters of a one-twentieth-normal solution of sodium hydroxide were used for the neutralization of the acid which had been formed by the incubation of 1 cc. of the

Histologic Finding and Amount of Olive Oil-Splitting Lipase in Ligation of the Common Bile Duct and of the Pancreatic Ducts

Ligation of the Common Bile Duct

	Day of Operation		2 Days Following Operation		4 Days Following Operation		7 Days Following Operation	
	H	L	H	L	H	L	H	L
Dog O- 1	1+	1.1	...	...	3−	2.1		
O- 2	1+	2.8	...	...	3+	3.6		
O- 3	2−	0.0	...	...	3+	2.5		
O- 4	—	0.2	...	...	6−	2.8		
B-10	1+	0.2	2+	0.2	...	...	3+	0.3
B-11	1−	0.1	2+	0.4	...	...	3+	0.4
B-71	1+	—	...	...	...	...	3+	0.2

Ligation of the Pancreatic Ducts

	Day of Operation		2 Days Following Operation		4 Days Following Operation		7 Days Following Operation		17 Days Following Operation	
	H	L	H	L	H	L	H	L	H	L
Dog P-13	...	...	—	3.2	—	4.4				
P-16	1+	0.0	2+	5.5	3+	5.0	...	...	3+	0.0
P-17	1+	0.1	1+	4.1	3+	4.4				
P-18	1+	2.6	4−	2.6						
P-19	—	0.0	—	4.4	2+	1.7	4−	1.2		
P-20	—	0.0	2+	5.1	2+	5.6	4−	6.6		

H, histologic findings in the spinal cord of rats after incubation with serum: 1+, mild swelling of myelin sheaths and axis cylinders in outer zones of the longitudinal sections; 2+, swelling more marked; staining of myelin sheaths present; 3+, marked swelling and fragmentation; pale staining of myelin sheaths; destruction of outer zones; 4+, complete demyelinization of outer zones with marked destruction and swelling with fragmentation of nerve fibers in inner zones.

L, amount of olive oil-splitting lipase, expressed in cubic centimeters of twentieth normal sodium hydroxide, which was used for the neutralization of the free acid.

serum with an emulsion of olive oil. The increase in lipases has no direct relationship to the toxic effect of the serums. While the amount of lipase was reduced to normal seventeen days following the operation, the serum was still very toxic. This destructive effect on the spinal cord of rats was not produced by fermentative action. This could be proved by heating the serums to 62 C. for thirty minutes in order to destroy the ferments present. Such heated serums had the same effect in test tube experiments as the unheated serums. Furthermore, we were able to demonstrate by the following arrangement that toxic substances, and not changes in the physicochemical make-up of the serums, were responsible for the destruction of the spinal cords: 150 cc.

of the serum of a dog whose common bile duct had been ligated thirty days previously was freed from proteins by coagulation with acetic acid and boiling. The filtrate was evaporated to dryness in vacuo and redissolved in 7.5 cc. of a phosphate-buffer solution of p_H 7.4. This solution was incubated with the spinal cord of rats. In longitudinal sections a marked destruction of myelin sheaths with swelling of the axis cylinders was found.

After the demonstration of toxic substances in the serums of dogs with hepatic damage in test tube experiments, the effect of these substances on the central nervous system of the animals on which operation had been performed was studied. Four brains of dogs with ligation of the common bile duct, two of dogs with ligation of the pancreatic ducts and five of dogs with Eck fistula were examined histologically. We thought that these relatively few experiments were sufficient, because only findings of other investigators were to be confirmed. Indeed, we found in the different brains the changes which have been described by Willemi, Kirschbaum, Rapoport and others. There were the widespread degenerative changes of nerve cells in the form of swelling, vacuolization and liquefaction. Besides these, neuronophagia was frequent, as was accumulation of glia nuclei in larger foci. It seemed that the deeper layers of the cortex were the more affected.

Besides these generalized changes, we found in the brains of three dogs, following ligation of the common bile ducts, histologic changes which seemed to be sufficiently interesting for detailed description. The period of survival was longer in these dogs than in those of other observers. The first dog had been killed by ether narcosis ten days after the operation, the second after twenty-one days and the third after thirty days. They had shown the usual clinical picture which develops a few days after the operation: general fatigue, drowsiness and a peculiar, stiff gait. The icterus had been marked, and in the serums an increase of lipases and toxins acting on the spinal cord of rats had been demonstrated.

In frontal sections through the first brain, which had been stained for myelin sheaths, large spongy foci were found at the inner wall of the lateral ventricle. Large empty spaces were surrounded by swollen myelin sheaths and their débris (fig. 2 *A*). Other sections of these regions were stained by the method of Alzheimer-Mann, of Davenport, and of Holzer and with cresyl violet, and frozen sections were prepared with Cajal's gold sublimate, Hortega's method for microglia, Anderson's victoria blue or with sudan III. In the environment of these foci a dense wall of glia cells was seen (fig. 2 *B*); among them were very large round or oval nuclei with a small zone of cytoplasm. The fibrous parts of this region could not be stained very definitely, quite in con-

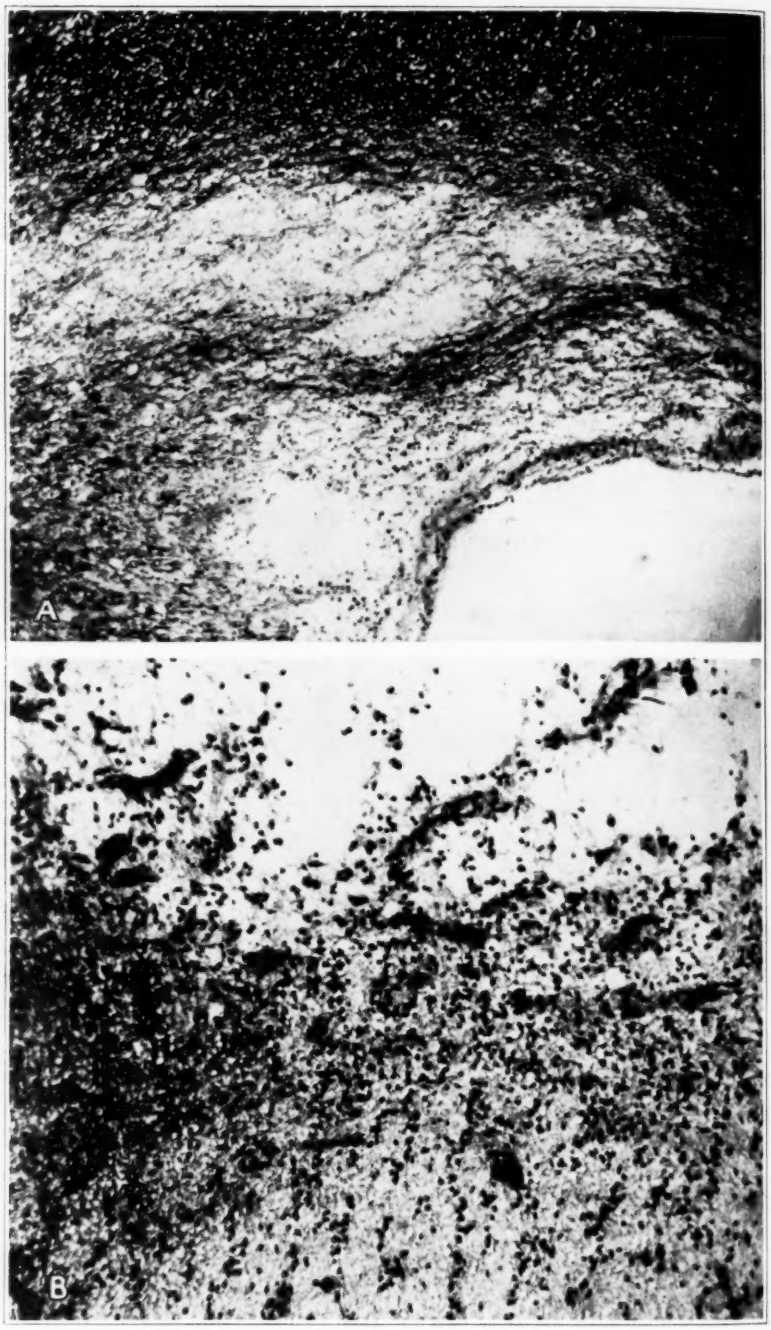

Fig. 2.—*A*, section from dog B-71, ten days after ligation of common bile duct; spongy necrosis of the wall of the lateral ventricle is seen. Weil stain; Leitz obj., 10 mm. ap.; ocul., 10 ×. *B*, inner wall of necrotic focus of figure 2*A*; it shows marked proliferation of glia with formation of large round or oval nuclei; Holzer stain; Leitz obj., 10 mm. ap.; ocul., 10 ×.

trast to the thick meshwork of fibrous glia in the adjacent subependymal tissue. Intermingled with the glia cells there were swollen myelin sheaths and axis cylinders. No gitter cells were present, and in sections stained with sudan III only isolated fat droplets were seen along the vessels. In the outer zone surrounding the glia wall the nerve cells showed shrinkage and vacuole formation. The blood vessels of this region were made prominent by a swollen wall, which stained homogeneously dark blue in Alzheimer-Mann preparations (fig. 3). There

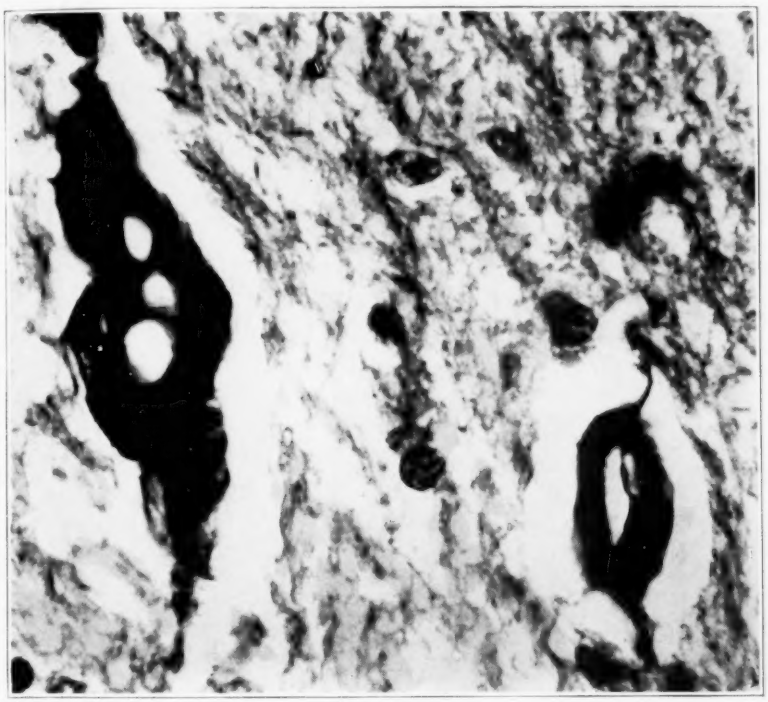

Fig. 3.—Blood vessels in the environment of necrotic focus of figure *2*; thickening and hyalin-like transformation of the vessel wall have occurred. Alzheimer-Mann stain; Leitz obj., 4 mm. ap.; ocul., 10 ×.

were no perivascular edema and no perivascular cellular infiltration. In the adjacent white matter an active increase of the interfascicular glia was seen. It was accompanied by an accumulation of fibrous astrocytes, and in the lower layers of the gray matter bordering these regions numerous foci of neuronophagia were found around degenerated nerve cells. In the middle layers of this cortex, the nerve cells showed different forms of edema, with distortion of the cytoplasm (fig. 4 *A*); in the outer layers most of the pyramidal cells were shrunken, staining darkly

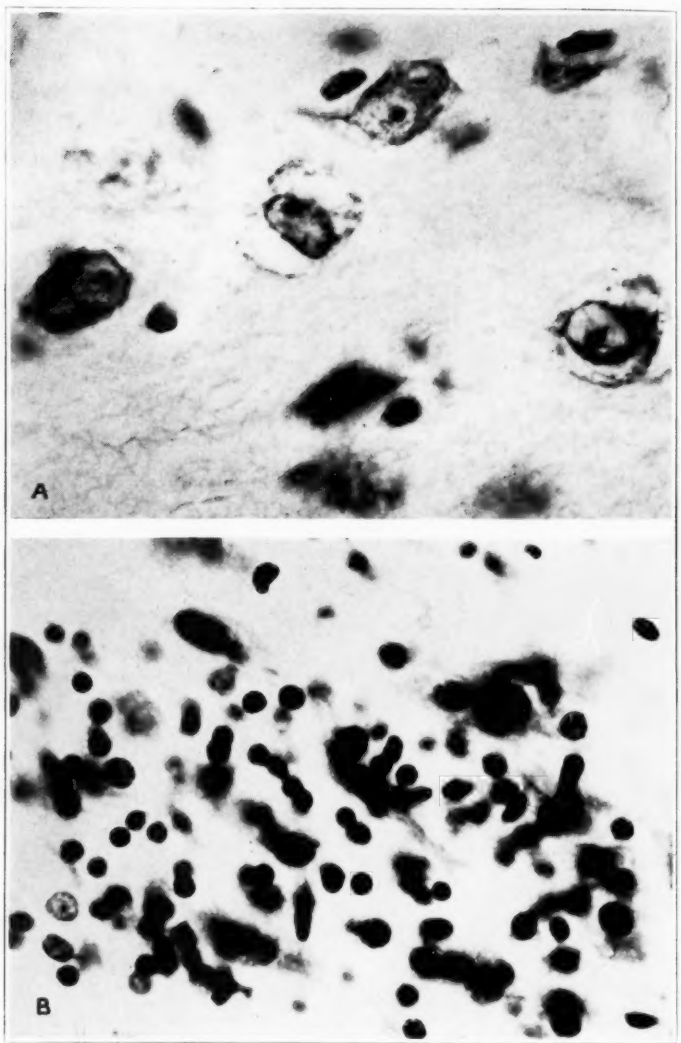

Fig. 4.—*A*, section from dog B-71, ten days after ligation of common bile duct which shows parietal cortex, fifth layer. Vacuolization and liquefaction of ganglion cells are shown. Cresyl violet stain; Zeiss obj., 3 mm. ap.; ocul., 10 ×. *B*, section from dog 139-D, three months after ligation of pancreatic ducts; a periventricular nucleus is shown. There are increase of glia nuclei with neuronophagia of degenerated ganglion cells. Cresyl violet stain; Zeiss obj., 3 mm. ap.; ocul., 10 ×.

with cresyl violet. The molecular layer was edematous and the pia-arachnoid covering it also showed a mild degree of edema.

The ependymal cells covering the ventricles were partly destroyed, especially near the spongy foci. At other places there was active proliferation, or the cells presented elongated forms with long processes extending in the subependymal tissue. The choroid plexus was severely damaged; it was covered with atrophic ependymal cells and was markedly edematous. In the periventricular nuclei an advanced destruction of ganglion cells and an active proliferation of glia with numerous neuronophagias were seen (fig. 4*B*). Such histologic pictures were also encountered in the basal ganglia and, even more pronounced, in the nuclei of the midbrain. The pons and cerebellum were less affected,

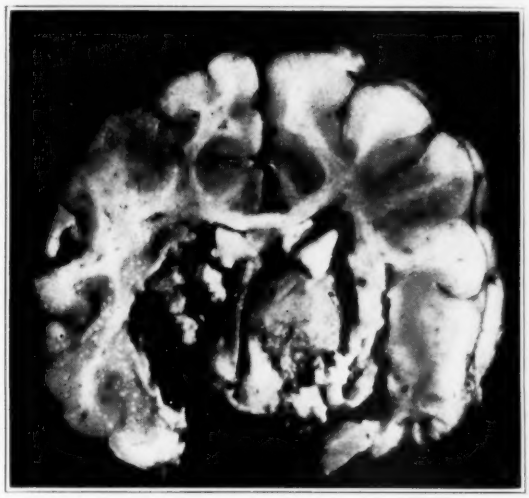

Fig. 5.—Section from dog 139-H, twenty-one days after ligation of common bile duct; this vertical section through the brain demonstrates destruction of the striatum and part of the internal capsule bilaterally.

and in the spinal cord the anterior horn cells were normal. Here the only marked change was edema surrounding the central canal, with swelling of adjacent nerve fibers.

The brain of the second dog offered a surprise when it was cut after ten days of fixation in formaldehyde. A frontal section through the third ventricle showed a complete destruction of the striate bodies on both sides; the tissue was spongy and friable (fig. 5). The anterior part of the caudate nucleus was preserved. In histologic sections the remains of the tissue in the environment of the destroyed area presented small perivascular hemorrhages and severe degeneration of nerve and glia cells. The former were swollen and vacuolated, and showed lique-

faction and convoluted dendrites which contained fine granules that were prominently stained. The glia nuclei were shrunken and partly fragmented. In the pons and cerebellum, perivascular hemorrhages among smaller vessels were seen; the endothelium and walls of the latter were swollen and edematous.

In the part of the striatum that had been preserved, a mild increase in glia nuclei was seen. The nerve cells seemed to be diminished in number and presented different stages of severe degeneration and neuronophagia (fig. 6). The cortical and thalamic nerve cells were

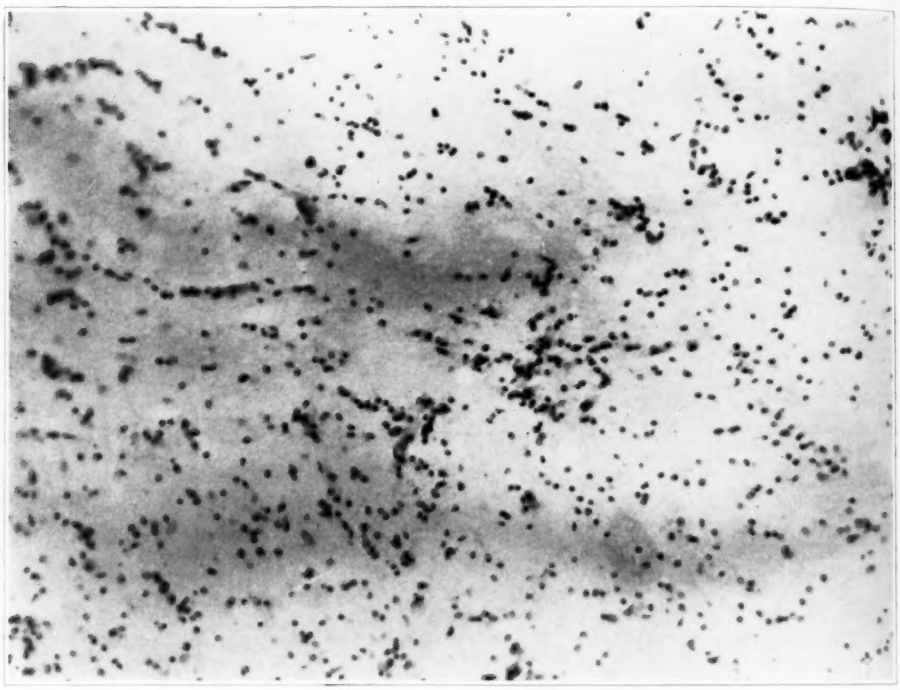

Fig. 6.—Section from dog 139-H, twenty-one days after ligation of common bile duct, which shows reduction in number of ganglion cells, degeneration and neuronophagia of remaining ganglion cells in striatum. Cresyl violet stain; Leitz obj., 10 mm. ap.; ocul., 10 ×.

relatively intact. The ependymal lining of the lateral and fourth ventricles was partly destroyed. The choroid plexus presented pictures similar to those in the first case. The pia-arachnoid was edematous and infiltrated with a few scattered small round cells and an increased number of fibroblasts.

In the brain of the third dog, which had been killed thirty days following ligation of the common bile duct, another type of distribution

of the toxic effect was found. The involvement of the choroid plexus and the environment of the lateral ventricles in the first two dogs suggest an elimination of the toxic substances through the choroid plexus and their highest concentration in these regions. In the third dog, however, the lateral ventricles were not much changed, and no foci of spongy destruction were found. There were, however, extensive foci of edema and demyelinization in the white matter of the cortex and around the blood vessels of the striatum (fig. 7 *A*). The former offered a different appearance as to form and size. Small foci of edema in the center of the white matter were more numerous, with marked swelling and destruction of myelin sheaths and axis cylinders and an increase in glia nuclei. The latter belonged in part to very large astrocytes, which surrounded these foci with a dense meshwork of coarse fibers. Also larger foci of demyelinization were seen, which in some places occupied the whole of the white matter of a gyrus (fig. 7 *B*). In sections stained for myelin sheaths they appeared homogeneous, without status spongiosus. In sections stained with cresyl violet, they were filled with densely accumulated glia nuclei, to which, in Holzer and Alzheimer-Mann preparations, a dense fibrous ground substance was added (fig. 8 *A*). Victoria blue preparations showed a dense feltwork of coarse glia fibers (fig. 8 *B*), while in the foci of demyelinization around the striate vessels this meshwork was formed by very fine fibers.

A fourth dog with ligation of the common bile duct, which had been killed after thirty days, showed pictures of nerve cell disease with neuronophagia in the deeper layers of the cortex, the basal ganglia and the midbrain similar to those in the other three. But both spongy destruction of brain substance and foci of demyelinization were absent.

One dog with ligation of the pancreatic ducts and severe fatty degeneration of the liver, killed after four months, showed a histopathologic picture similar to that of the first dog. The spongy destruction in the walls of the lateral ventricle was milder than that previously described. The nerve cell disease with neuronophagia seemed to be confined more to the midbrain and to the cornu ammonis formation. In the latter the fascia dentata was most severely involved, presenting large islands of glia, surrounding and invading the foci of ganglion cell destruction.

The brains of five dogs in which an Eck fistula had been produced and which survived for from one to six months presented in only one case, of six months' survival, a more intensive picture of nerve cell disease and glia proliferation than had been described by former observers. In none of them were there the severe parenchymatous changes which we have described as following ligation of the common bile duct.

In twenty white rats, weighing from 170 to 250 Gm., the common bile duct was ligated under pentobarbital sodium anesthesia. Fourteen of them survived. They were killed at intervals of from eight to thirty-five days, and the brains and spinal cords were fixed in formalde-

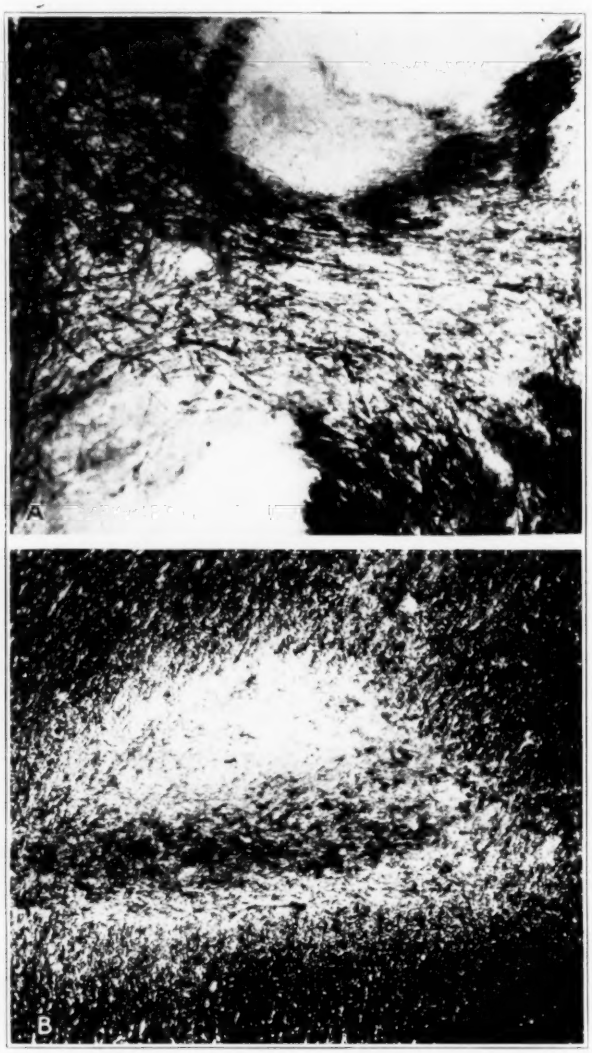

Fig. 7.—*A*, section from dog 7, thirty days after ligation of common bile duct, which shows areas of demyelinization around the blood vessels in the neostriatum. Weil stain; Leitz obj., 10 mm. ap.; ocul., 10 ×. *B*, section from dog 7, thirty days after ligation of common bile duct; focus of demyelinization in the white matter of the central cortex is seen. Weil stain; Leitz obj., 10 mm. ap.; ocul., 10 ×.

hyde. Histologic examination of the liver showed severe degenerative changes of the liver cells which, however, judging from the degree of fatty degeneration in sections stained with sudan III, were not so far

Fig. 8.—*A*, section from same focus as in figure 7, in which is seen increase of glia nuclei within the focus. Alzheimer-Mann stain; Leitz obj., 10 mm. ap.; ocul., 10 ×. *B*, section from same focus as in figure 7. Victoria blue stain, which shows formation of dense fibrous glia felt. Zeiss obj., 3 mm. ap.; ocul., 10 ×.

advanced as in the livers of dogs which had survived for the same length of time. The central stump of the ligated duct was dilated to

the size of a hazelnut and filled with bile. The brains of rats which had been killed within a period of three weeks following the operation did not show any marked histologic changes. Later, diffuse perivascular hemorrhages were found in different regions of the brain and spinal cord, without, seemingly, any predilection for certain areas. The endothelium of the vessels involved was swollen, and the walls were edematous. In three rats, small foci of softening were found around such lesions. In all of those which survived longer than twenty-five days, nerve cell degeneration of different intensity was found to be most pronounced in the basal ganglia, the midbrain and the cerebellar nuclei, and less in the cortical cells. Pictures of mild swelling or more severe vacuolization with liquefaction were present. In four rats, proliferation of glia was noticed at the same time, with neuronophagia of diseased nerve cells in the striatum and midbrain nuclei. In none of the brains that were studied were severe changes in the choroid plexus or the ependymal lining of the ventricles noticed. Foci of spongy necrosis, of demyelinization or of intensive glial proliferation as described in the ligated dogs also were absent.

COMMENT

In animal experiments the direct relationship between liver disease and pathologic condition of the brain is more evident than in human material. Test tube experiments have demonstrated that toxic substances are circulating in the serums following ligation of the common bile duct or the pancreatic ducts. These produce destruction and changes of the nerve fibers of the spinal cord of rats similar to those found in the spongy necrosis of the wall of the ventricles or in the edematous foci of the white matter. The intensive glial proliferation proves that these were not merely postmortem changes. In the third dog, with intensive bilateral destruction of the striate bodies, the possibility should be considered that this massive breaking down of nerve tissue occurred as an autolytic postmortem process. But this could occur only after preparation of the tissue through the diffuse softening in connection with multiple perivascular hemorrhages. Similar massive destruction of both striate bodies has been described in dystonia musculorum progressiva and is seen in hepatolenticular degenerations.

The severe damage of the choroid plexus in most of the dogs points to the possibility that here the toxic substances were eliminated into the cerebrospinal fluid. They affected most severely the walls of the lateral ventricles and the surrounding tissues, because here their concentration was the highest. With decreasing concentration toward the center of the brain and the surface of the hemispheres, the toxic action

was diminished and only nerve cell degeneration and stimulation of glial growth occurred. In the third dog a different mode of elimination of the toxic substances seemed to have taken place. The foci of demyelinization around blood vessels, combined with overgrowth of fibrous glia, point to the vessel wall as the filter through which they had passed. It seems that this manner of elimination was the rule in the rats on which operations had been performed. The perivascular hemorrhages which were found three weeks after the operation, together with the swelling of the endothelium and the edema of the vessel walls, support strongly such an assumption.

An interesting feature in the experiments on the dogs was the localization of cortical nerve cell degeneration with neuronophagia in the deeper layers bordering the white matter. Normally this region is more abundant in glia nuclei than the middle and upper layers of the cortex, a fact which may explain the more intensive glial proliferation. Furthermore, the striatum was not spared in any of the experiments on ligation, although, with the exception of dog 3, midbrain nuclei and, to a lesser degree, the pons and cerebellum were affected. In the experiments on rats the cortical nerve cells were affected only in two experiments; in the rest the degeneration of nerve cells and glial proliferation were more pronounced in the midbrain, pons and cerebellum.

If one studies the histopathologic conditions in cases of Wilson's disease and pseudosclerosis, or in combinations of lenticular degeneration and hepatic disease which had presented similar clinical symptoms, one will find the following outstanding features: (1) the symmetrical destruction of the striatum, which is most pronounced in the putamen and less in the globus pallidus and caudatum; it may present itself in the form of intensive destruction with the formation of large cavities, milder "status spongiosus" or merely a marked edema; (2) severe degeneration of nerve cells, which is also found in the cerebral cortex or in the dendate nucleus and (3) proliferation of glia, which in some cases seems to produce a fibrous wall around the destroyed areas, and in other cases tends to undergo degeneration. Large, pale glia nuclei with irregular outlines have been described, sometimes in multinuclear giant cells (Alzheimer's glia cells). In most of the cases the mesenchyme does not participate actively. The wall of the blood vessels may show hyaline degeneration, but no perivascular cellular infiltration or proliferation has been found. In some cases of pseudosclerosis, marked proliferation of capillaries has been described in the putamen and dendate nucleus.

If one limits a comparison of this group of hepatic diseases and pathologic conditions of the brain, in which the clinical picture was closely related to the original Wilson's disease and the pseudosclerosis

group, some histologic features can be found which are also common to the experimental conditions. Very striking is the bilateral destruction of the middle third of the neostriatum in the second dog, with the severe degeneration of the remaining nerve cells. The histologic picture of the diseased cortical nerve cells resembled closely the generalized degeneration described in Pollak's cases. The proliferation of glia and the formation of large glia nuclei with irregular outlines of the membranes resembled pictures described in Wilson's disease and pseudosclerosis. The hyaline degeneration of the vessel walls in the environment of the spongy foci is another common feature. The diffuse foci of edema of the white matter, with a transition to status spongiosus and proliferation of glia, as was seen in the third dog, resembles histologic pictures described in cases of pseudosclerosis.

Such cases of combination of hepatic disease with more or less localized disease of the striatum and with a well defined clinical symptom complex will, naturally, attract the attention of the clinician and the pathologist more than the vague nervous manifestations which are common to chronic diseases of the liver. The frequent combination of chronic hepatic disease with arteriosclerosis or with infectious diseases makes it impossible in most cases to draw any conclusions as to a direct relationship between histopathologic changes of the central nervous system and intoxication following hepatic disease.

Such a relationship is more definitely established in experiments with animals. It is evident from the experiments with dogs that one and the same etiologic factor may produce a variety of combinations of pathologic lesions, which may be explained by the different mode of distribution of the toxic substances and by a variation in their concentration. One should concede the same possibility to similar cases in the human being, in which a direct relationship between diseases of the liver and those of the brain seems to be established. This would be in favor of a closer approach of the points of view of the clinician and of the pathologist. The one tries to establish disease entities based on the observation of pathophysiologic manifestations. The other knows that the underlying pathologico-anatomic manifestations may be brought about by one and the same etiologic factor, acting with different intensity on different parts of the nervous system. He also knows that different etiologic factors may produce identical anatomic lesions, which manifest themselves as the same clinical entities. Such a point of view will prevent one from expecting stereotyped encephalopathies in hepatic disease or from assuming dogmatically one and the same etiology for all cases of hepatolenticular degeneration. It also will prevent one from falling into another extreme: the assumption that the different histopathologic features (status spongiosus, glial proliferation and liver

cirrhosis) are predetermined genetically, and that the combination of these different genes is responsible for the variety of clinical pictures.

SUMMARY AND CONCLUSIONS

1. Following hepatic damage by ligation of the common bile duct or the pancreatic ducts of dogs there appear substances in the serum, on the fourth day approximately, which act destructively on the spinal cord of rats in test tube experiments. These toxins are not identical with the lipases, which are increased simultaneously.

2. These toxins are eliminated through the choroid plexus or through the wall of the cerebral vessels. The latter type of elimination seemed to be predominant in white rats in which the common bile duct had been ligated.

3. The toxic effect is most pronounced at the place of elimination and highest concentration. Here a spongy necrosis of the walls of the ventricles or foci of edema and demyelinization in the cortex are produced. In all cases a diffusely spread disease of the nerve cells is present. Proliferation of glia occurs simultaneously with the formation of dense felts of fibrous glia. The mesenchyme is not engaged in the disease process.

4. In comparing cases of pathologic conditions of the human brain associated with liver disease and experiments with animals, the following common features are noticed: spongy necrosis of nerve tissue, active proliferation of glia with the formation of large, round or oval nuclei, diffuse nerve cell disease with predilection for the deep cortical layers and the striate body and absence of active mesenchymal reaction.

RÔLE OF VESTIBULAR NUCLEI IN THE CORTICAL INNERVATION OF THE EYE MUSCLES

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It is almost generally agreed that the posterior longitudinal fasciculus carries not only labyrinthine but also voluntary impulses to the muscles of the eye (Spitzer,[1] Muskens [2] and Spiegel and Tokay [3]), but it is still uncertain how the cortical impulses enter this bundle. Marburg,[4] for instance, conjectured that these impulses, after having traveled within the internal capsule and in the peduncle and crossed in the midbrain or the cranial part of the pons, enter directly into this bundle; in such a case, one would expect to find degeneration in the fasciculus longitudinalis posterior after injuries of the cortical centers or of the internal capsule, but this has never been observed. Hence, subcortical gaze centers have been conjectured in many places: in the thalamus (Spitzer [1]), in the corpora quadrigemina (Adamük [5]), in the sixth nucleus (Wernicke [6]) and in the formatio reticularis (Monakow and Bárány [7]). But, as Marburg has already pointed out, there exists no evidence that a gaze center is located in the thalamus. Bernheimer,[8] Bechterew [9] and Niessl von Mayendorf [10] have shown that the corpora quadrigemina are not necessary for the transmission of cortical impulses to the muscles of the eye. In my experiments in cooperation with

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1. Spitzer, A.: Arb. a. d. neurol. Inst. a. d. Wien. Univ. **6**:1, 1899.

2. Muskens, L.: J. Comp. Neurol. **48**:267, 1929; Monatschr. f. Psychiat. u. Neurol. **76**:268, 1930.

3. Spiegel, E. A., and Tokay, L.: Arb. a. d. neurol. Inst. a. d. Wien. Univ. **32**:138, 1930.

4. Marburg, O.: Deutsche Ztschr. f. Nervenh. **41**:41, 1911

5. Adamük: Arch. f. Ophth. **18**:153, 1872.

6. Wernicke: Arch. f. Psychiat. **7**:513, 1877.

7. Bárány, R.: Nervöse Störungen des Cochlearis und Vestibularapparats, in Lewandowsky, M.: Handbuch der Neurologie, Berlin, Julius Springer, 1910, vol. 1, pt. 2.

8. Bernheimer, in Graefe-Saemisch: Handbuch der gesamten Augenheilkunde, Leipzig, Wilhelm Engelmann, 1899, p. 101.

9. Bechterew, W.: Les fonctions nerveuses, Paris, O. Dion & Fils, 1909, vol. 2.

10. von Mayendorf, Niessl: Arch. f. Ophth. **104**:293, 1921.

Dr. Ken Taga,[11] not only the tectum mesencephali but the dorsal wall of the aqueduct with the posterior commissure was destroyed; lateral movements of the eyes could still be elicited by stimulation of the frontal lobe or of the internal capsule. These experiments prove that the nuclei of the ocular muscles can be reached by cortical impulses, even though the thalamofugal or pallidofugal fibers in the posterior commissure are destroyed, which fibers some authors (Muskens [2] and Spitzer [1]) supposed to be the pathway for such impulses to the posterior longitudinal fasciculus. Cases of complete destruction of the abducens nucleus with retention of the conjugate movement of the contralateral eye inward prove that the center for lateral movement cannot be situated in this nucleus itself, as Riley [12] mentioned also in his review.

The alleged gaze center in the formatio reticularis was supposed (particularly by Bárány, and recently by Lorente de Nó [13]) to be identical with a center for the fast component of nystagmus. But, in experiments in which the brain stem was injured from the ventral side, Spiegel [14] was able to produce extensive injuries of the formatio reticularis without injury to fibers from the vestibular nuclei into the posterior longitudinal fasciculus. In these experiments I observed, in spite of the lesions of the substantia reticularis, the fast as well as the slow component of horizontal or vertical nystagmus after stimulation of the labyrinth.

At present there is no evidence of a subcortical gaze center, but the existence of a relay station of the corticofugal impulses to the muscles of the eye, before they enter the posterior longitudinal fasciculus, must be assumed, as injuries of the internal capsule or of the peduncle are not followed by degeneration of fibers of the fasciculus longitudinalis posterior.

Another fact proves that the cortical impulses for conjugate movements of the eyes have to pass some subcortical cell group before reaching the posterior longitudinal fasciculus. The experiments of Sherrington [15] showed that the reciprocal inhibition observed in conjugate deviation of the eyes after cortical stimulation can still be noticed if the internal capsule is stimulated. In other words, the origin of the

11. Taga, K.: Arch. f. d. ges. Physiol. **223**:116, 1929.

12. Riley, H. A.: The Central Nervous System Control of the Ocular Movements and the Disturbances of This Mechanism, Arch. Ophth. **4**:640 (Nov.); 885 (Dec.) 1930.

13. Lorente de Nó, R.: Die Labyrinthreflexe auf die Augenmuskeln, Berlin, Urban & Schwarzenberg, 1928.

14. Spiegel, E. A.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **25**:200, 1929.

15. Sherrington, C. S.: Integrative Action of the Nervous System, New Haven, Conn., Yale University Press, 1920, p. 280.

reciprocal inhibition has to be localized in the subcortex. A cortical impulse producing, for instance, movements of both eyes to the right side stimulates the right external and the left internal rectus, and it inhibits the left external and the right internal rectus. It is nearly generally agreed that the neurons of the nucleus abducens innervating the external rectus are associated with the nuclear center of the opposite internal rectus through the posterior longitudinal fasciculus. The assumption that each fasciculus longitudinalis posterior carries the impulses for a lateral movement of both eyes to its own side (Spitzer[1]) was confirmed by direct stimulation of this bundle in experiments by Scala and myself.[16] If it is true that the right posterior longitudinal fasciculus associates the right external and the left internal rectus and that the left posterior longitudinal fasciculus carries impulses to their antagonists, and if one agrees that this bundle is the pathway for cortical impulses to the nuclei of the ocular muscles, the reciprocal inhibition of the muscles of the eyes obtainable even by direct excitation of the internal capsule (Sherrington) must be explained in the following way: An impulse, for instance starting in the left cortex and inducing horizontal movement of both eyes to the right side, stimulates the right external and the left internal rectus through impulses carried by the right posterior longitudinal fasciculus; if the antagonistic muscles, i. e., the left external and the right internal rectus, relax at the same time, the left posterior longitudinal fasciculus which unites the nuclear centers of these muscles must be inhibited. In other words, the corticofugal impulses to the muscles of the eyes must be distributed, before entering the posterior longitudinal fasciculus, in such a way that the fibers on the opposite side are stimulated and the fibers on the same side are inhibited. It is known, through the experiments of Bartels[17] and de Kleyn,[18] that the law of reciprocal inhibition is in force not only in cortical but also in labyrinthine innervation of the muscles of the eyes. To innervate a conjugate deviation of both eyes to the right side, for instance, the labyrinthine impulses also must be distributed in such a way that the right posterior longitudinal fasciculus is stimulated and the left inhibited. Such a distribution is performed easily in the vestibular nuclei, which send impulses to the posterior longitudinal fasciculus on the same as well as on the opposite side, as was pointed out in detail by Teschler and myself.[19]

16. Scala, N. P., and Spiegel, E. A.: Effect of Stimulation of the Posterior Longitudinal Fasciculus on the Eye Muscles, Arch. Ophth., to be published.

17. Bartels, M.: Arch. f. Ophth. **76**:1, 1910; **78**:129, 1911.

18. de Kleyn, A.: Arch. f. Ophth. **107**:480, 1922

19. Spiegel, E. A., and Teschler, L.: Arch. f. d. ges. Physiol. **222**:359, 1929.

The question arises whether the corticofugal impulses might use the neurons of the vestibular nuclei to reach the posterior longitudinal fasciculus. The anatomy of this bundle is rather well known; it contains two groups of fibers: descending fibers starting in the nucleus of Darkschewitsch, the nucleus interstitialis of Cajal and the nucleus intracommissuralis (Marburg [20]), and ascending fibers starting in the vestibular nuclei. The corticofugal impulses for ocular movements could be carried either by the descending or by the ascending fibers of the posterior longitudinal fasciculus. The first possibility was assumed by Spitzer [1] and Muskens,[2] who believed that the cortical impulses reach these descending fibers through the posterior commissure. It has already been mentioned that my experiments with Taga [11] are contradictory to this hypothesis. Hence, the second of the two possibilities, the conduction of the cortical impulses to the muscles of the eyes through the ascending fibers of the posterior commissure, i. e., through neurons of the vestibular nuclei, must be considered.

If the neurons of the vestibular nuclei should carry not only vestibular but also cortical impulses to the posterior longitudinal fasciculus, the question of the subcortical gaze center would be solved, and also the reciprocal inhibition in cortical innervation of the ocular muscles could be explained. To answer these questions, experiments were performed in cooperation with Dr. Teschler; [19] in these experiments the vestibular nuclei were destroyed on both sides, and the effect of the stimulation of the eye center in the frontal lobe was studied before and after the injury. These experiments showed that the bilateral lesion of the vestibular nuclei changed the effect of the cortical stimulation. Instead of the normal horizontal deviation of the eyes to the opposite side, after such injuries vertical movements were observed. Sometimes, if only a part of the vestibular nuclei was injured, horizontal or rotary movements to the side of the stimulation were noticed. These experiments suggested that the impulses from the frontal lobe to the muscles of the eyes, particularly those for horizontal movements of the eyes, have a relay station in the vestibular nuclei before entering the posterior longitudinal fasciculus.

It seemed of interest to study whether the same is true for the impulses that originate in the occipital lobe, particularly in regard to the mechanism of optomotor nystagmus. The observations of Cords [21] warrant his assumption that, at least in man, optomotor nystagmus is a cortical reflex, having its center in the occipital lobe. The centrifugal fibers of this reflex arc start in the lateral surface of the

20. Marburg, O., in Alexander, G., and Marburg, O.: Handbuch der Neurologie des Ohres, Berlin, Urban & Schwarzenberg, 1923, vol. 1, p. 293.

21. Cords, R.: Arch. f. Ophth. **117**:58, 1926.

occipital lobe and run on the inner side of the corticopetal fibers within Gratiolet's radiation. The further pathway of the motor branch of this reflex arc is, however, hypothetic.

Ohm,[22] in a study of miners' nystagmus, supposed a supranuclear subcortical center (Zitterganglion), which possibly could be identical with a subcortical gaze center, localized in the midbrain or in the ventrocaudal part of the nucleus of Deiters. He considered the possibility that optic, vestibular and central (cortical) impulses enter this "Zitterganglion"; but his observation that a nystagmus produced by rotation can be different in the dark and in the light [23] proves only that labyrinthine and optic impulses meet somewhere in the central nervous system. They do not allow a more exact localization of this place.

Cords [21] conjectured that the centrifugal impulses from the occipital lobe, as well as the impulses from the frontal lobe, enter a subcortical gaze center in the neighborhood of the sixth nucleus. As there is no evidence of the existence of such a center, and as it has been shown in my experiments with Teschler [19] that the vestibular nuclei play a rôle in the conduction of the impulses from the frontal lobe to the muscles of the eyes, it seemed worth while to study the effect of injuries of the vestibular nuclei on the transmission of impulses from the occipital lobe to the ocular muscles.

MATERIAL AND METHOD

The experiments that were undertaken were performed on eleven cats, in which first the fourth ventricle was opened and its floor exposed in the usual way (the membrana atlanto-occipitalis was opened, and adjacent parts of the occipital bone were removed). Then the surface of the occipital lobe was stimulated, and the ocular movements following stimulation of its different parts were noted. To injure the vestibular nuclei or their fibers into the posterior longitudinal fasciculus an incision was made on the inner side of the restiform body, in some experiments first on the side opposite the stimulated cortex, and in other experiments first on the homolateral side. After an observation of the effect of this injury on the ocular movements elicited by cortical stimulation, the vestibular nuclei were injured in the same way on the second side, and the occipital lobe was again stimulated. In some experiments the reaction of the eyes was observed only before and after bilateral injury of the vestibular nuclei. The extent of the lesion was studied in serial sections stained with toluidine blue. In order to be able to recognize the right and the left side on the slides, a small incision was made in the right pyramidal tract of the hardened brain.

The following example shows the effect of the lesions on the ocular movements.

Cat F6.—On Feb. 7, 1932, at 11:20, the left occipital lobe was exposed and the fourth ventricle opened (table 1).

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22. Ohm, J.: Das Augenzittern der Bergleute, in Alexander, G., and Marburg, O.: Handbuch der Neurologie des Ohres, Berlin, Urban & Schwarzenberg, 1926, vol. 3, p. 596.

23. Ohm, J.: Arch. f. Ophth. **126**:221, 1931.

TABLE 1.—*Experiment on Cat F6*

Stimulated Area	Time	Distance of Coils, Cm.	Movement of Eyes	Comment
Gyrus ectosylvius posterior	12:08	7.0	Right and left, deviated to right; nystagmus to right	Clonism of right ear more marked than of left
Gyrus suprasylvius posterior	12:10	8.0	Right and left, deviated to right; nystagmus to right followed by vertical nystagmus downward	.....
Gyrus suprasylvius posterior	12:14	7.0	Right and left, horizontal nystagmus to right	Generalized convulsions
	12:25	(Incision on inner side of left restiform body)		
Gyrus ectosylvius and suprasylvius posterior	12:26	7.0	Right and left, deviated to right; some few nystagmoid movements to right	.....
	12:39	(Incision on inner side of right restiform body, good spontaneous respiration)		
Gyrus ectosylvius posterior	12:44	7.5	Right and left, upward	.....
Gyrus ectosylvius posterior	12:45	7.5	Right and left, upward	.....
Gyrus suprasylvius posterior	12:46	7.5	Right and left, upward, slight horizontal nystagmus to right; very small amplitude of nystagmus	.....
Gyrus ectosylvius posterior	12:48	7.5	Right, deviated to right Left, deviated upward	.....
In intervals between stimulations animal had a spontaneous rotary nystagmus to left				
Gyrus suprasylvius and ectosylvius posterior	.....	7.5	Right, deviated to right; then rotary nystagmus to left Left, deviated upward; then vertical nystagmus downward; slight rotary component to left	.....
Gyrus suprasylvius posterior	12:56	7.5	Right, deviated to right; then nystagmus to right Left, deviated upward; then nystagmus downward	Generalized convulsions
	3:25	...	Right and left, spontaneous slow vertical downward movements	.....
Gyrus suprasylvius and ectosylvius posterior	3:25	7.5	Right, upward; then short movement to right Left, upward	Generalized convulsions
	3:35		Right and left, spontaneously deviated downward	.....
Gyrus ectosylvius posterior	3:37	7.5	Right and left, upward	.....
Gyrus suprasylvius posterior	3:37	7.5	Right, upward, slightly to right Left, upward	.....
Gyrus ectosylvius posterior	3:39	7.5	Right and left, upward	.....
Gyrus suprasylvius posterior	3:46	7.5	Right, upward; then horizontal nystagmus Left, upward; then vertical nystagmus	.....
	3:50	7.5	Right and left, upward	.....

Histologic Examination.—On both sides, incisions were found on the inner side of the cell groups of the descending root of the vestibular nerve (fig. 1). In more cranial levels, a hemorrhage was found on the inner side of the left nucleus of Deiters; the injury ended on the left side ventral from the nucleus of Bechterew. In the medial part of the right nucleus of Deiters, the injury was divided into two punctures, which were found in the medial part of Deiters' nucleus. The cranial end of the injury on the right was located in the nucleus sensibilis trigemini in the pons, and cranial from that outside the brachium conjunctivum. The formatio reticularis was reached by the puncture only in the most caudal levels on the left side, on slides through the dorsal nucleus of the vagus and in its most dorsal parts. However, no injury of the formatio reticularis was found in more cranial levels, especially in the neighborhood of the sixth nucleus.

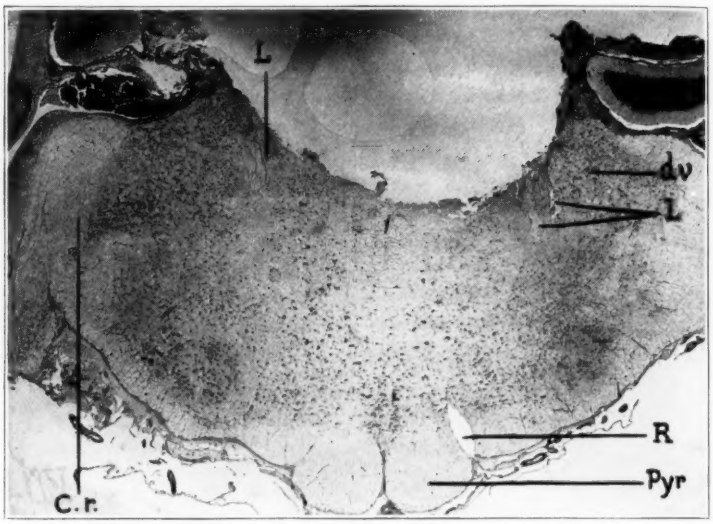

Fig. 1 (cat F6).—*C.r.* indicates the corpus restiforme; *d.v.*, the cells of the descending root of the vestibular nerve; *L.*, the lesion; *Pyr.*, the pyramidal tract; *R.*, the postmortem incision on the right side.

RESULTS OF EXPERIMENTS

The results of the stimulation experiments on eleven cats before and after injury of the vestibular nuclei are summarized in table 2.

Stimulation was performed seventy-two times after exposure of the fourth ventricle, but without any other injury to the vestibular nuclei, a small pledget of cotton being introduced into the ventricle in case of hemorrhage. Eleven times the occipital centers for ocular movements were stimulated after one-sided injury to the vestibular nuclei and fifty-eight times after bilateral injury. Whereas in some experiments the stimulation of the occipital lobe before the injury of the vestibular nuclei produced not only horizontal or rotary movements of the eyes to

the opposite side, but also vertical movements, in others only horizontal movements were elicited before the lesion. Purely horizontal conjugate deviation to the opposite side was observed thirty-four times, or in 47.2 per cent of the seventy-two stimulations. If one considers also cases in which horizontal movement was combined with a rotary component or in which purely rotary movements of both eyes to the opposite side were elicited, the conjugate lateral movement to the opposite side was observed thirty-nine times before the lesion of the vestibular nuclei (54.1 per cent of the seventy-two stimulations). Purely vertical move-

TABLE 2.—*Movements of the Eyes Elicited by Stimulation of the Occipital Lobe*

	Fourth Ventricle Opened: Vestibular Nuclei Intact	Vestibular Nuclei Injured on One Side	Vestibular Nuclei Injured on Both Sides
No reaction	..	1	3
Conjugate deviation to opposite side:			
(a) Horizontal	34 (47.2%)	3	2 (3.4%)
(b) Horizontal and rotary	3 39 (54.1%)	..	..
(c) Rotary	2	..	..
(d) Oblique	1	1	..
(e) Horizontal in both eyes with vertical component in one eye	4	..	..
Conjugate deviation to the same side	2	..	6
Skew deviation	2	..	..
Conjugate vertical movement	4 (5.5%)	2	22 (37.9%)
Conjugate vertical movement with rotary component in one eye	..	..	3 28 (48.2%)
Conjugate vertical movement with horizontal component on one eye	..	..	3
Mixed reactions:			
Vertical then horizontal	1	1	3
Horizontal then vertical	3	1	..
Horizontal then oblique	..	1	..
Rotation then vertical	1	..	..
Dissociated movements:			
One eye vertical, the other horizontal	6	1	4
One eye vertical, the other rotary	2	..	3
One eye vertical, the other no reaction	..	..	7
Convergence	5	..	..
Divergence	..	..	2
L eye horizontal to opposite side; R (?)	1	..	..
L eye vertical; R (?)	1	..	..
	72	11	58

ments followed the stimulation only four times (5.5 per cent). The rest of the observations were convergence movements, mixed reactions (e.g., first horizontal, then vertical), dissociated movements (horizontal or rotary movement of one eye and vertical movement of the other) or such reactions in which a sure movement of the eye could be noticed only in one eye and the direction was not sure in the other owing to the smallness of the amplitude or to the quickness of the reaction. Each of the last mentioned groups of reactions was observed only a few times, before as well as after injury of the vestibular nuclei; it does not seem possible to draw conclusions from these last groups of reactions, and the statistical comparison is therefore limited to the lateral

and the vertical conjugate movements of the eyes before and after injury to the vestibular nuclei. It may be mentioned that the observation of dissociated movements of the eyes following cortical stimulation might be due partly to slight injuries of the floor of the fourth ventricle, such as the pressure of the cotton pledget introduced into the ventricle after the exposure of its floor. Scala and I [16] noticed that direct stimulation of the posterior longitudinal fasciculus sometimes produces dissociated ocular movements, and I have observed a dog in which histologic examination revealed a slight injury of one posterior longitudinal fasisculus when cortical stimulation produced dissociated movements of the eyes.[24]

A unilateral incision on the inner side of the restiform body, whether opposite or homolateral to the stimulated cortical area, was not able to change sufficiently the effect of the cortical stimulation on the eyes. After bilateral injury of the vestibular nuclei three times (5.2 per cent) stimulation of the cortex could not produce ocular movements, although clonus of the skeletal muscles and dilation of the pupils showed that the cortex was well excitable. As already mentioned, the statistical comparison will be limited to observations in which bilateral vertical or bilateral lateral movements were observed. After lesion of the vestibular nuclei on both sides, stimulation of the occipital lobe produced purely vertical ocular movements twenty-two times (37.9 per cent of fifty-eight stimulations).

If one adds the observations in which the bilateral vertical movement was combined with a horizontal (three times) or a rotary component (three times) of one eye, bilateral vertical ocular movements were elicited twenty-eight times (48.2 per cent) after lesion of the vestibular nuclei as compared with 5.5 per cent before the lesion. Purely conjugate deviation to the opposite side was elicited only twice (3.4 per cent as compared with 47.2 or 54.1 per cent before injury). Particularly in cases in which stimulation of the occipital lobe, before injury of the vestibular nuclei, produced only a conjugate deviation of the eyes to the opposite side without vertical movements, the change of the reaction (the appearance of vertical movements of the eyes) after lesion of the vestibular nuclei was striking.

COMMENT

These observations can be explained if one makes the same assumption for impulses from the occipital lobe to the muscles of the eyes as did Teschler and myself for impulses from the frontal lobe: The cortical impulses for associated lateral ocular movements use the neurons

24. Unpublished observations.

of the vestibular nuclei of both sides to enter the posterior longitudinal fasciculus, whereas these nuclei are not necessary for cortical innervation of conjugate vertical movements of the eyes. So long as the vestibular nuclei are intact, cortical stimulation is able to produce horizontal movements or rotary as well as vertical movements of the eyes. The impulses for horizontal movements might even be stronger than those for vertical movements, so that in some cases only horizontal movements are observed as a consequence of cortical stimulation. But, if one injures or severs the pathway for the lateral movements of the eyes by bilateral injury to the vestibular nuclei, the vertical component

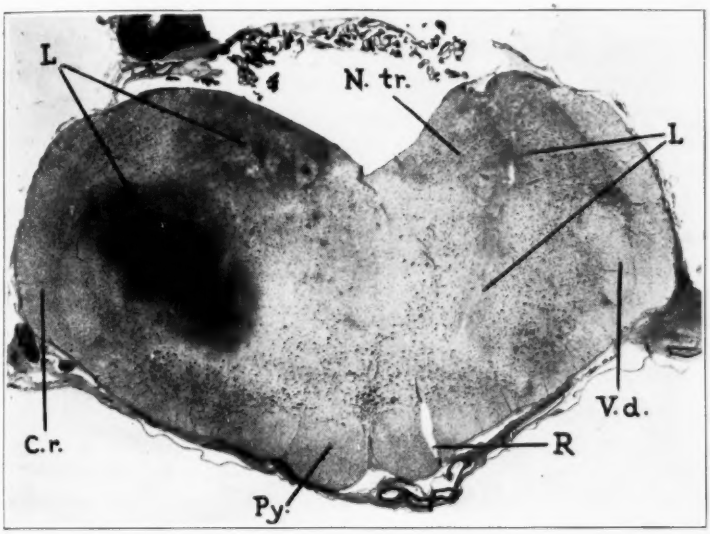

Fig. 2 (cat F3).—*C.r.* indicates the corpus restiforme; *L.*, the lesion; *N.tr.*, the nucleus triangularis; *Py.*, the pyramidal tract; *V.d.*, the descending root of the trigeminus; *R.*, the postmortem incision on the right side.

of the movements of the eyes is predominant, or even is present alone. In incomplete injuries of the vestibular nuclei, the horizontal movements might be more or less retained.

The following case of incomplete lesion of the vestibular nuclei merits particular mention as the direction of the horizontal movement was changed in such a way that the eyes were moved toward the side of the stimulation instead of toward the opposite side.

CAT F3.—On Dec. 7, 1931, the left cortex was exposed and the fourth ventricle opened. The results are given in table 3.

Histologic Examination.—Left Side: A large hemorrhage was present in the nucleus triangularis, extending to the substantia reticularis on the inner side of the substantia gelatinosa trigemini (fig. 2). The fibers from the cell groups of the

TABLE 3.—*Results of Experiments on Cat F3*

Stimulated Area	Time	Distance of Coils, Cm.	Movement of Eyes	Comment
Gyrus suprasylvius and ectosylvius posterior	11:15	8.0	Right and left, to right	.....
Gyrus ectosylvius posterior			Right and left, to right; then nystagmus to right	.....
Gyrus suprasylvius posterior			Right and left, to right; then nystagmus to right	.....
	11:25	(Incision on inner side of left restiform body, asphyxia, artificial respiration till 12:05, then spontaneous respiration)		
Gyrus suprasylvius and ectosylvius posterior	12:05	6.5	Right and left, no movement; dilatation of pupils of both eyes	Clonism of right ear
	12:09		Right and left, spontaneous convergent movements	.....
Gyrus ectosylvius posterior	12:15	6.5	Right and left, horizontal nystagmus marked to right	.....
	12:20	(Incision on inner side of right restiform body, asphyxia, artificial respiration)		
Gyrus ectosylvius and suprasylvius posterior	12:26	6.5	Right and left, no movement; dilatation of pupils	.....
	12:28			Spontaneous respiration
Gyrus ectosylvius posterior	12:31	6.5	Right and left, horizontal movements; nystagmus to side of stimulation Left, rotary component to left	.....
Gyrus ectosylvius posterior	12:35	6.5	Right and left, horizontal movements; nystagmus to left	Clonism of right facial muscles
	12:36		Right and left, spontaneous horizontal undulation	Movement to left perhaps faster
Gyrus ectosylvius posterior	12:37	7.0	Right and left, nystagmus to left; rotary component to left	.....
	12:43		Right, spontaneous horizontal nystagmus; fast component to left	.....
	12:44		Right and left, spontaneous horizontal nystagmus to left	Weaker on left eye than right
	12:46	(Asphyxia, cortex not well excitable, artificial respiration)		
	12:53		Right, slight spontaneous horizontal nystagmus to left	
Gyrus ectosylvius posterior	12:55		Right and left, divergent movements	.....
Gyrus suprasylvius posterior	12:56		Right and left, deviated to left	.....
Gyrus suprasylvius posterior	12:58		Right and left, deviation to left; nystagmus to the left	Marked dilatation of pupils
Gyrus suprasylvius posterior	1:00		Right and left, deviation to left; nystagmus to the left	Followed by spontaneous horizontal nystagmus to left

descending root of the vestibular nerve toward the fasciculus longitudinalis posterior were severed by this injury. The left nucleus of Deiters and the nucleus of Bechterew were normal.

Right Side: A hemorrhage was present in the lateral parts of the nucleus of Deiters and of the nucleus of Bechterew. At more caudal levels, this injury was continued by an incision through the nucleus triangularis, which reached far into the substantia reticularis. The fasciculus longitudinalis posterior was intact, although the hemorrhage in the left nucleus triangularis came very close to this bundle.

After incomplete bilateral injury of the vestibular nuclei, stimulation of the occipital lobe in this case produced a conjugate movement toward the side of stimulation, as Teschler and I also observed in some experiments on the frontal lobe. How is this change of direction to be explained? The experiments of Leidler [25] on rabbits have shown that injuries of the caudal part of the vestibular nuclei produce nystagmus toward the side of injury. It might be that the different parts of the vestibular nuclei have also a different influence on the direction of horizontal movements of the eyes observed after cortical stimulation. The change of direction in the aforementioned case could then be explained by the fact that on the left side the nuclei of Deiters and Bechterew were intact, and only the caudal part of the vestibular nuclei was injured. However, another factor must also be considered. Lorente de Nó [13] supposed that impulses conducted through the substantia reticularis might help to determine the direction of nystagmus. As in this case the injury reached far into the substantia reticularis in the caudal parts of the rhombencephalon, particularly on the left side, the injury to this region might be partly responsible for the change of the direction of the conjugate deviation in cases like that of cat F3. Further experiments with isolated injuries of the formatio reticularis will have to answer this question.

But even if such an influence of the substantia reticularis exists, it should be emphasized that vertical movements of the eyes instead of horizontal deviation were observed after bilateral injuries of the vestibular nuclei, even if the substantia reticularis was injured at the most in its most caudal and dorsal parts, adjacent to the nucleus triangularis, or only near the nucleus dorsalis vagi. In the neighborhood of the sixth nucleus, where an alleged gaze center has been supposed to be, the substantia reticularis was found normal in cases that showed predominance of conjugate vertical movements of the eyes instead of horizontal ones after injuries of the vestibular nuclei. These experiments seem, therefore, to support the assumption that the vestibular nuclei play a rôle

25. Leidler, R.: Arb. a. d. neurol. Inst. a. d. Wien. Univ. **20**:256, 1913; **21**: 151, 1914.

in the conduction of cortical impulses to the muscles of the eyes, as far as lateral movements of the eyes are concerned; this applies to impulses from the occipital lobe as shown in this paper, and to impulses from the frontal lobe, as shown by Teschler and myself.[19]

One might object that corticofugal fibers could not be traced as far as the vestibular nuclei. But it should be remembered that connections between parts of the nervous system are generally accepted even though parts of the respective tracts have not yet been proved. It is, for instance, difficult to prove by the degeneration method even that fibers of the pyramidal tract reach the cells of the anterior horns (Obersteiner[26]), and some authors assume, therefore, that a neuron is intercalated between the pyramidal tract and the anterior horn cells. No one doubts that retinal impulses reach the sphincter center in the oculomotor nucleus, although the part of the reflex are between the endings of the optic tract in the corpus quadrigeminum anterius and the sphincter nucleus is still anatomically uncertain. So far as the anatomy of the cortical innervation of lateral deviation of gaze is concerned, one has to decide whether one considers the ascending or the descending fibers of the posterior longitudinal fasciculus as a corticofugal pathway to the ocular muscles if one accepts the importance of the posterior longitudinal fasciculus for this innervation. My experiments with Taga[11] make it improbable that the descending fibers of this bundle carry impulses for lateral conjugate movements; the ascending fibers of this bundle seem, therefore, the only pathway which can carry the cortical impulses for lateral deviation of gaze, and it is well known that these fibers take origin in the vestibular nuclei. Hence, anatomy seems to corroborate the localization of the center for lateral gaze in the vestibular nuclei. It is possible that the cortical impulse, before reaching the vestibular nuclei, is interrupted in some subcortical cell group; whether corticofugal fibers reach the vestibular nuclei directly or whether neurons are intercalated between the cortex and the vestibular nuclei cannot yet be determined.

One might raise the objection that the change of direction of ocular movements observed after bilateral injuries to the vestibular nuclei is due to loss of tonic labyrinthine reflexes on the muscles of the eyes, which reflexes might be necessary to guarantee a normal reaction of the ocular muscles to cortical impulses. But control experiments proved that bilateral extirpation of the labyrinth did not produce such a change of the ocular movements induced by cortical stimulation as did destruction of the vestibular nuclei on both sides. Hence, the assumption

26. Obersteiner, H.: Anleitung beim Studium des Baues der nervösen Zentralorgane im gesunden und kranken Zustände, Vienna, Franz Deuticke, 1912, pp. 334 and 450.

seems justified that at least a part of the cortical impulses from the frontal lobe, as well as from the occipital lobe, use the neurons of the vestibular nuclei to reach the posterior longitudinal fasciculus.

SUMMARY

1. Bilateral injuries to the vestibular nuclei change the direction of the movements of the eyes elicited by stimulation of the occipital (Spiegel), as well as of the frontal, lobe (Spiegel and Teschler).

2. Conjugate deviation of the eyes to the side opposite the stimulated cortical area, in particular, depends on the intactness of the vestibular nuclei. After exposure of the floor of the fourth ventricle, stimulation of the occipital lobe produced conjugate lateral ocular movements to the opposite side in 54.1 per cent and vertical deviation of the eyes in 5.5 per cent of the experiments. After bilateral lesions of the vestibular nuclei, stimulation of the occipital lobe produced lateral deviation to the opposite side in 3.4 per cent and vertical deviation in 48.2 per cent of the experiments.

3. The experiments are explained by the assumption that the vestibular nuclei play an important rôle in the cortical control of the muscles of the eyes for lateral movements. The neurons of the vestibular nuclei seem to carry impulses not only from the labyrinth, but also from the frontal and occipital lobe into the posterior longitudinal fasciculus.

MYELOMALACIA IN STREPTOCOCCUS HAEMOLYTICUS MENINGITIS

A CLINICOPATHOLOGIC STUDY OF A RARE COMPLICATION IN MENINGITIS

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Transverse lesions of the spinal cord occurring in the course of meningitis are usually of the nature of a myelitis. Here there is a real infection of the cord to which the degeneration may be ascribed. Extremely rare, however, is a simple softening of the cord from deprivation of blood supply due to a thrombus in the spinal cord arteries. The latter is true myelomalacia, which was the finding in the case that we report here.

The symptom complex of myelomalacia is the same as that of a transverse myelitis and the diagnosis in our case was acute transverse myelitis of infectious origin or possibly acute hemorrhagic transverse myelitis. Although Streptococcus haemolyticus meningitis is usually a fatal disease, it was thought that this patient was recovering before the sudden onset of the spinal symptoms.

Sachs [1] reported two cases of unusual forms of acute myelitis, one of which showed a softening due to a thrombosis of the arteries in the course of general arteriosclerosis.

In 1916, Hassin [2] reported the histopathologic changes in five cases of myelitis, only one of which was a case of real myelomalacia.

REPORT OF A CASE

Clinical History.—E. D., aged 47, a widow, was admitted to the New York Post-Graduate Hospital on Nov. 10, 1930, complaining of severe, continuous,

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From the Departments of Neurology and Otology of the New York Post-Graduate Medical School, and the Department of Neuro-Pathology of the New York State Psychiatric Institute and Hospital, Columbia University.

1. Sachs, B.: Some Unusual Forms of Acute Myelitis, Tr. A. Am. Physicians **19**:497, 1904.

2. Hassin, G. B.: Histopathologic Changes in Five Cases of Myelitis, M. Rec. **90**:619 (Oct. 7) 1916.

lancinating pain in the left ear of twelve hours' duration, which was said to have followed an attack of grip. Examination revealed marked hyperemia with a purulent discharge in the left naris and a furuncle in the left external auditory canal, which started to discharge on the next day. Pressure over the left mastoid elicited extreme pain. From November 12 to 14, the patient had less pain in the ear, but generalized pain in the head and occasional vomiting. By November 17, she had become drowsy and irrational and soon was comatose. There was slight rigidity of the neck, but no Kernig sign. A roentgen examination revealed diminished illumination in the left mastoid, suggesting an exudative infiltration, and a mastoid operation was performed. The mastoid cells were filled with a serosanguineous fluid and showed an occasional area of pus. The dura over the petrous portion of the temporal bone, as far as the tip, was normal. The dura in Trautman's triangle was incised, and a thick purulent spinal fluid, under increased pressure, was withdrawn.

On November 19, the patient was conscious and cooperative during an examination. Severe pain in the suboccipital and lower spinal regions was the chief complaint. There were marked rigidity of the neck and a bilateral Kernig sign. The pupils were 3 mm. in diameter and reacted promptly to light and in convergence. There was no paralysis of the extrinsic ocular muscles. Nystagmoid jerks, lateral in direction, both to the left and right, were observed in each eye. The fundi were normal. The facial movements were normal, and the tongue was protruded in the midline. The deep reflexes both in the upper and in the lower extremities were equally hyperactive. The abdominal reflexes were not elicited on either side. A plantar reflex was obtained on both sides. The nonequilibratory coordination tests of the upper and lower extremities were normally performed. Adiadokokinesis was not present, and skilled acts were normally performed. There were no abnormal involuntary movements. Muscle strength and tone were normal. A general sensory examination gave normal results for all senses. The diagnosis was purulent meningitis of undetermined origin.

On November 24, there was slight motor weakness in the lower extremities, and the patient complained of a girdle-like pain about the level of the umbilicus. On November 26, the neurologic findings were those of complete paralysis in the lower extremities, and complete loss of sensation from the eleventh thoracic dermatome downward. There was a band of hyperesthesia and hyperalgesia from the ninth to the eleventh thoracic dermatomes. All superficial and deep reflexes were lost. There were abdominal distention and urinary retention. At this time a diagnosis was made of transverse myelitis, probably infectious in origin. The opinion was that the lesion was intramedullary rather than extramedullary, and surgical intervention was not advised.

There were no changes later in the neurologic signs; death occurred as the result of a purulent cystitis and pneumonia on Jan. 1, 1931.

On Nov. 19, 1930, a blood culture showed no growth after twenty-four hours. The spinal fluid was cloudy, and the white cells numbered 6,040, of which 90 per cent were polymorphonuclear leukocytes. Response to the butyric acid test was 4 plus. Cultures of the spinal fluid and of pus taken from the mastoid cells showed Streptococcus haemolyticus. The spinal fluid continued cloudy throughout the illness, but the white cells diminished until they numbered 120, of which 64 per cent were polymorphonuclear leukocytes. The cultures, which at first showed three hemolytic colonies yielding streptococci, later showed one. Blood cultures were sterile. On admission to the hospital, urinalysis gave negative results except for a slight trace of albumin.

On the day of admission, the temperature was 101.8 F. and it continued between 100 and 101 F. until November 18, when there occurred a rather sudden rise to 103.4 F. Immediately following this elevation of temperature, the mastoid operation and first lumbar puncture were performed. The temperature gradually lowered, and from November 25 until December 30 constantly remained low, ranging between 98 and 100.2 F. Just before death there was a sharp rise in temperature. Treatment consisted in drainage through the dural opening in Trautman's triangle and repeated lumbar punctures. No chemical solution or serum was used.

Pathologic Examination.—A. Macroscopic: In the sacral region the dura was adherent to the leptomeninges and spinal cord. In the lumbar region the dura showed considerable thickening, suggesting a pronounced pachymeningitis which involved all its posterior half. At the level of the high lumbar and low dorsal

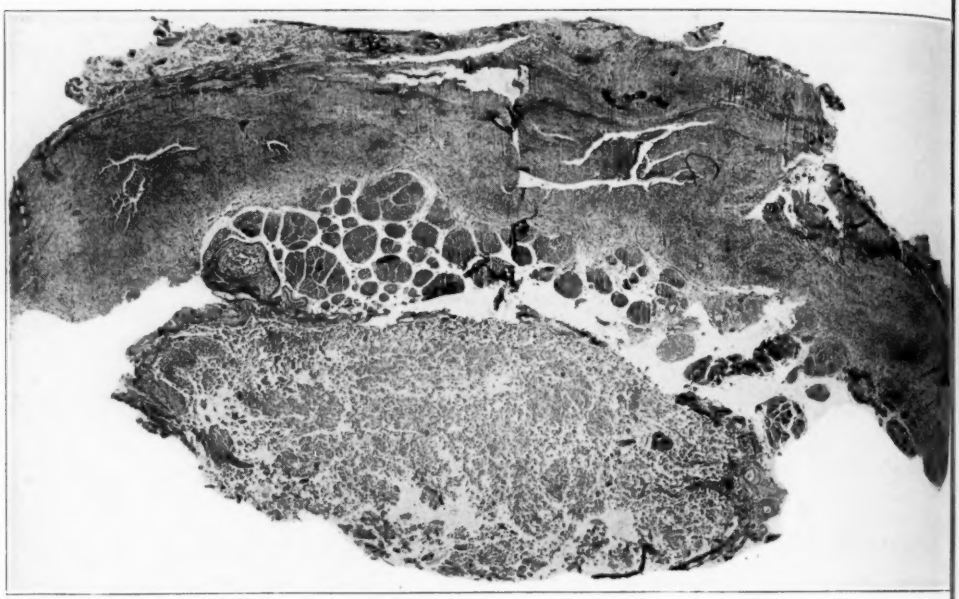

Fig. 1.—Complete softening of the spinal cord at the level of the lumbosacral segments. Note the severe meningeal process involving both dura and soft meninges and resulting in considerable thickening of the coverings. Hematoxylin and eosin stain.

segments the thickening of the dura and of the underlying meninges was more on the right side.

The spinal cord at the level of the sacral and lumbar segments consisted of a softened material in which no structure could be recognized (fig. 1). At the level of the low dorsal segments (from the tenth to the twelfth) there were a diffuse though less pronounced process of disintegration and a small area of softening in the left posterior column (fig. 2). Higher up, the area of softening was larger and invaded the gray matter of the posterior horn and, to a less extent, the anterior horn of the same side (fig. 3). A little higher, the area of softening was definitely located in the left posterior horn. The whole right side was free from softening. At the level from the fifth to the seventh dorsal segments, this area was limited

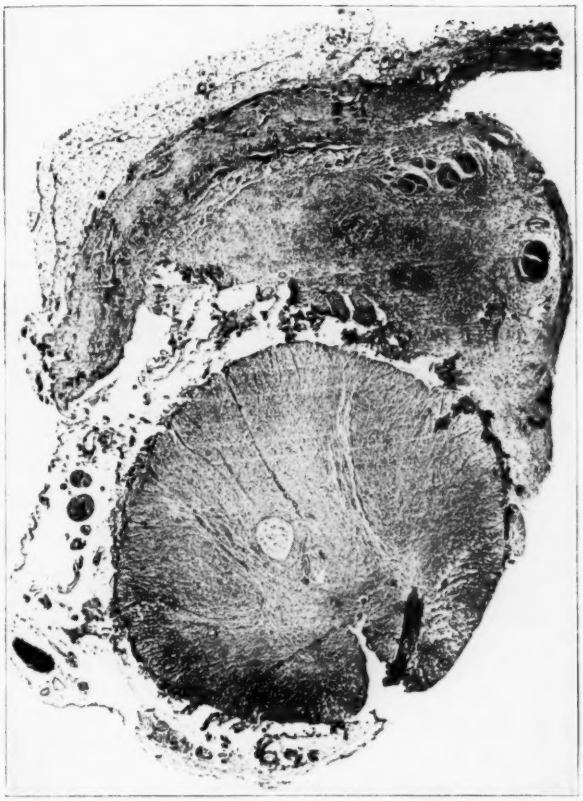

Fig. 2.—Small cavity in the left posterior column (from the tenth to the twelfth dorsal segments). Note the severe meningeal process over the right side. Hematoxylin and eosin stain.

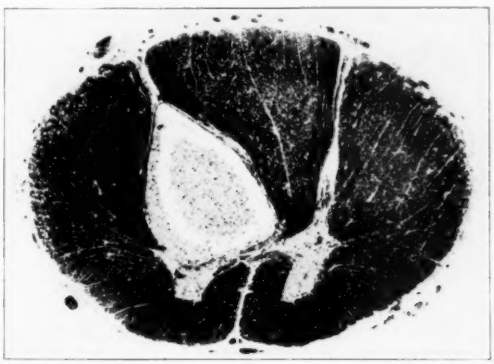

Fig. 3.—Good-sized cavity invading the posterior horn of the left side. The cavity contains a considerable number of scavenger cells (ninth thoracic segment). Weigert stain for myelin sheaths.

to the left posterior horn. At the levels of the third and fourth dorsal segments, a very small area of softening was definitely limited to the posterior horn. At the level of the second dorsal segment, the area of softening had completely disappeared.

B. Histologic: The lumbosacral segments revealed disintegrated tissue occupying the whole area of the spinal cord. In the disintegrated material some nerve cells were present, but were undergoing degeneration. No topographic division was possible between what had previously been the gray and the white matter. Small blood vessels were surrounded occasionally by inflammatory elements, the most internal of which consisted of lymphocytes. In the disintegrated tissue numer-

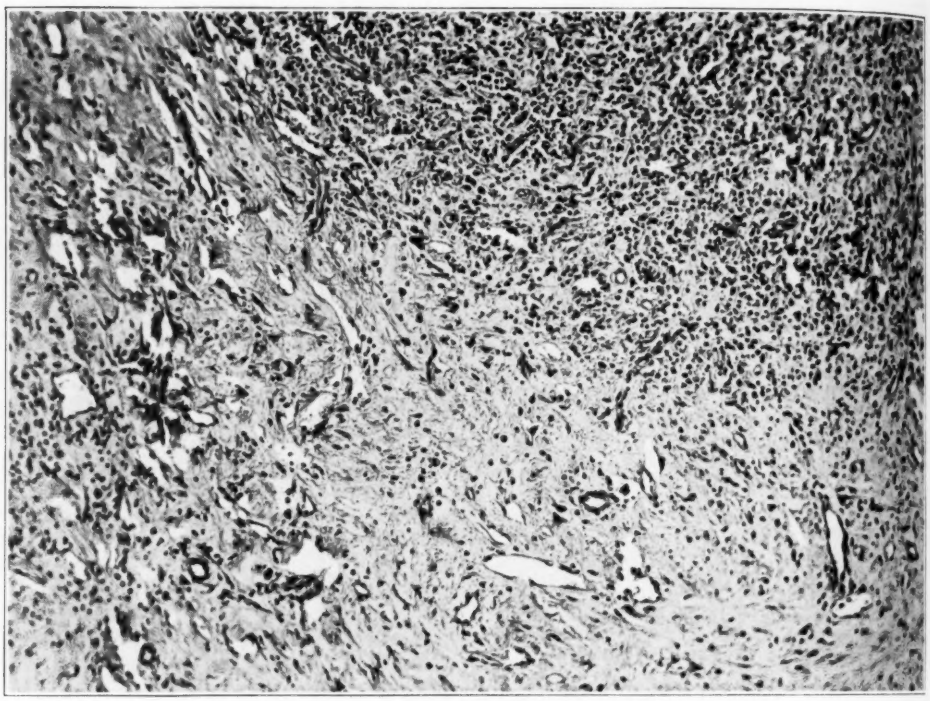

Fig. 4.—Details of the subacute inflammatory process in the stage of organization. Hematoxylin and eosin stain.

ous large mononuclear cells of the so-called phagocytic type were present, and intermingled with them were fragments of myelin sheaths and nerve fibers. Large bands of connective tissue were encountered, representing the remnants of the meningeal septums.

The tremendous thickening of the meninges was represented externally by a thickened dura mater, to which a considerable amount of newly formed connective tissue had been added. Between the connective tissue elements, either free or surrounding the blood vessels, there were infiltrative elements—lymphocytes, a few plasma cells, generally degenerating, and large mononuclear cells. Not infrequently, areas were found in which the inflammatory reaction was severe, the tissue being entirely represented by newly formed blood vessels, some surrounded by

large numbers of infiltrative cells. In the inner layer of the thickening the infiltrative and neoformative changes invaded the soft meninges, especially on the left side of the spinal cord. The innermost layer representing the pia disclosed degenerative changes represented by homogeneization of the tissue associated with a still active inflammatory reaction.

Altogether, the meninges were the seat of a process which might be termed a subacute type of inflammation, in which organization was taking place (fig. 4). The organization was not uniform all over and areas were seen in which the exudative changes predominated over the reparative ones.

The changes involving the blood vessels may be divided into two categories, the progressive and the regressive. The progressive ones were represented mainly by a considerable neoformation of blood vessels. Occasional progressive changes

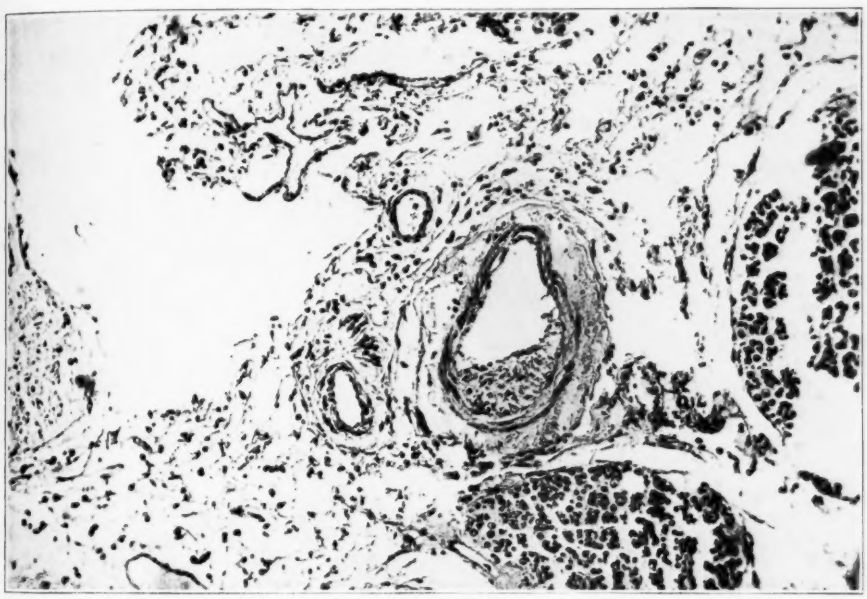

Fig. 5.—Parietal thrombus of the blood vessel of the pia in the stage of organization. Hematoxylin and eosin stain.

consisted of hypertrophy of the media and of the subendothelial areas, resulting in a narrowing of the lumen of the blood vessels without definite participation of the intima. In those areas, necrosis was occasionally encountered, involving the previously hyperplastic tissue. The degenerative changes were represented by loosening of the adventitia and media, occasionally followed by homogeneization of the tissue. A few blood vessels were undergoing a hyaline type of degeneration, leading to a more or less complete occlusion of the lumen. Finally, thrombi were seen in all stages of development. At times the thrombus formation developed concentrically and at others was more of the parietal type (fig. 5), on one side of the blood vessel wall. Blood vessels the lumens of which were completely occluded by an organizing thrombus (fig. 6) were numerous.

The softening of the entire cord disappeared gradually as one proceeded from the sacrolumbar to the dorsal segments. At the level of the eleventh and twelfth

dorsal segments, the structure of the spinal cord was again recognizable in regard to topographic distinction between gray and white matter. At this level the meninges were considerably thickened over the right side, where the dura was still adherent to the soft meninges. Both dura and soft meninges were still the seat of a diffuse subacute inflammatory process, the details of which did not vary substantially from those described in the lumbosacral segments. The meninges of the anterior portion of the spinal cord showed definite signs of inflammation, but the process was far from reaching the severity of the involvement of the posterior meninges, and, besides, it was limited to the soft meninges. The spinal roots embedded in the organized exudate of the posterior region showed degenerative changes, whereas the anterior roots appeared more normal.

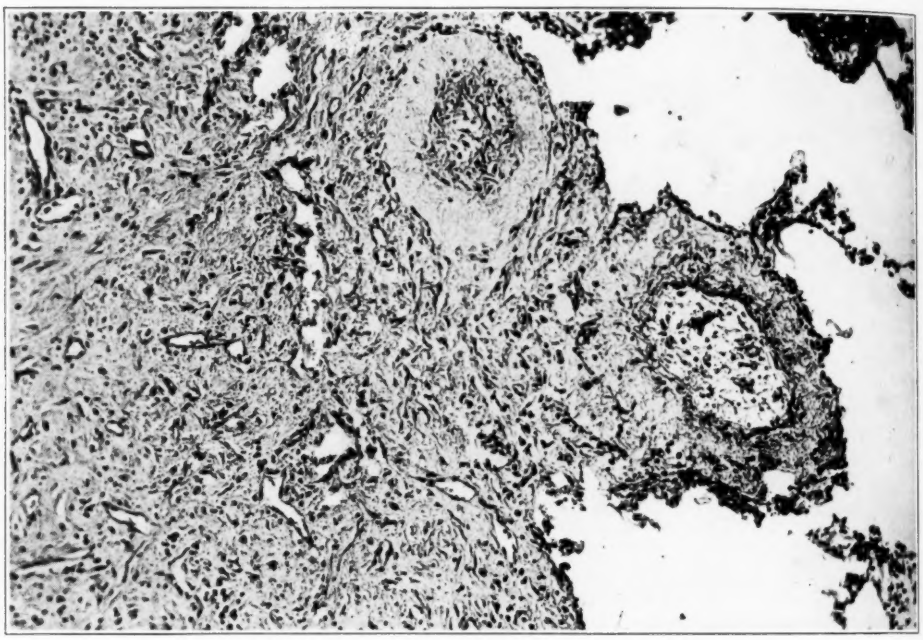

Fig. 6.—Thrombosis of blood vessels leading to complete occlusion of the lumens. Both thrombi are in a stage of organization. Hematoxylin and eosin stain.

The spinal cord tissue itself was the seat of diffuse disintegration which, however, still allowed the topographic recognition of gray and white substance. In the white substance, degeneration was more pronounced in the posterior columns, where most of the tissue had a disintegrated spongelike appearance. The lateral and anterior columns were altogether better preserved, though in the anterior columns of the right side a large area of disintegration was encountered. In the gray matter, the nerve cells were surrounded by dilated perineuronal spaces and the majority of them were degenerating. The posterior horns of both sides were considerably degenerated. A new element that made its appearance at this level was a small area in the anterior portion of the left posterior column which con-

tained remnants of tissue intermingled with a large number of scavenger cells. No inflammatory changes pointing to myelitis were found.

At the level of the eighth and ninth thoracic segments, the meningeal thickening of the dura had completely disappeared, whereas the soft meninges still showed slight traces of inflammatory reaction. At this level the outstanding pathologic finding was a large necrotic area occupying the left posterior horn and the posterior portion of the anterior horn. The soft material in this area produced a deformity of the posterior columns, with displacement of the structures toward the right side. The elements included in this area were débris of myelin sheaths, nerve fibers and particularly numerous compound granular cells, the origin of which was naturally mixed, partly from the mesoderm and partly from the glia. The white substance of the spinal cord showed an areolar type of degeneration, especially around the periphery. The areolas were represented by a distended net of the glial framework from which the axis-cylinders had more or less completely disappeared.

At a still higher level, the sixth and seventh dorsal segments, the necrotic area which has been described was now entirely limited to the middle portion of the left posterior horn. As one proceeded upward, it was reduced in size and at the level of the third and fourth thoracic segments it was very small. At the level of the first and second thoracic segments the necrotic area was entirely absent. At the level of the higher thoracic and cervical segments, even the meningeal reaction was absent and only occasional lymphocytes were to be seen in the slightly thickened soft meninges. There was a certain amount of thinning out of the white matter of the low cervical segments in the posterior columns, as the result of ascending degeneration, and around the periphery of the cord, possibly from edema secondary to stasis in the cerebrospinal fluid.

COMMENT

The interesting feature of this case was the fact that the clinical picture was the result of the organization of a pachymeningitis and leptomeningitis of the lumbosacral region. This inflammatory thickening could by itself have been responsible for symptoms of pressure and the vascular changes which had occurred at this level. At the beginning these changes must have accounted for a certain amount of compression of arteries and veins, resulting in a slowing of the circulation of the blood. The slowing of the circulation of the blood, associated with chemical changes produced in situ and a possible invasion of the blood vessel walls by the infectious agent, must have resulted in damage of the lining endothelium of the blood vessels and subsequent formation of thrombi. The latter were numerous and were present in both arteries and veins, especially in the territories where the exudate was thickest.

The sudden onset of paraplegia might be related to the rapid formation of a thrombus invading important branches of the spinal arteries and resulting in a sudden myelomalacia of the lumbosacral region.

That we were dealing with a vascular condition is also proved by the fact that in the lower dorsal segments, above the area of complete

softening in the lumbosacral cord, a necrotic area was found in the area of supply of the left posterior spinal artery, and higher, in the upper dorsal segments, this area was limited to the vascular territory of small branches of the same artery.

The process of myelomalacia described in this case has nothing in it of an inflammatory nature and differs essentially from a myelitic process as already described by Bassoe and Hassin.[3]

The myelomalacia explains the motor symptoms that occurred in the lower extremities, and the necrotic area in the posterior column region of the gray decussation accounts for the sensory changes, which extended as high as the ninth thoracic level. At this level, in fact, this area, though mostly invading the posterior horn, was undoubtedly interfering through pressure with the fibers of the commissure as well as of the posterior columns, and only higher up did it remain localized in the gray matter without deforming the latter.

Many methods have been used in the treatment of streptococcus meningitis, but for none has the claim been made that the method used caused the patient's recovery. It is thought, in this case, that laminectomy to assist in drainage might possibly have acted to prevent the development of the localized pachymeningitis and leptomeningitis with the resultant softening of the cord.

SUMMARY AND CONCLUSIONS

1. A case is presented of myelomalacia of sudden onset as the result of a Streptococcus haemolyticus meningitis.

2. The necropsy findings consisted of leptomeningitis and pachymeningitis in the lumbosacral region with occlusion of the vessels of the spinal cord by pressure and the formation of a thrombus, resulting in myelomalacia.

3. Above this, an area of softening in the left posterior horn and column, secondary to a thrombosis of the posterior spinal artery, accounted for anesthesia up to the level of the ninth thoracic dermatome.

DISCUSSION

DR. CHARLES A. MCKENDREE, New York: We have all encountered cases of myelomalacia associated with arteriosclerotic disease of the spinal vessels and of the aorta, syphilitic disease of the spinal cord and that secondary to compression of the cord. We are also familiar with necrosis associated with transverse myelitis. So-called myelitis is more frequently degenerative than inflammatory, and when degenerative it is not myelitis. Ascending necrosis of the spinal cord, probably due to an acute infection, without evidence of inflammation or thrombosis or other lesions of the blood vessels, has been carefully studied by Feindel.

3. Bassoe, P., and Hassin, G. B.: Myelitis and Myelomalacia, Arch. Neurol. & Psychiat. **6**:36 (July) 1921.

Bassoe and Hassin, in 1921, reported a total transverse lesion of the cord in the midthoracic region, showing total necrosis and marked cavity formation at a higher level. In this particular instance, the emphasis laid on the importance of the implication of the veins and arteries of the cord, secondary to meningitic invasion, is well founded on histopathologic findings.

In postmeningococcic infections in which myeloradicular signs are prominent sequelae, undoubtedly vascular changes within the cord substance would be found as well as degenerative states secondary to exudative processes involving the nerve roots primarily.

In this case a diffuse cerebrospinal meningitis, manifesting its chief ultimate pathology in the lumbosacral segments, demonstrated definite vascular changes as high as the upper thoracic segments. It is possible that the cerebrum itself may have shown similar vascular insults.

Dr. Leon H. Cornwall, New York: The importance of this case, in my opinion, attaches to the fact that the authors have convincingly demonstrated in a case of diffuse inflammatory disease the presence of an area of myelomalacia in the spinal cord secondary to thrombotic changes in the blood vessels and not, as one might expect, due to the inflammatory disease per se. It was, however, probably induced by the pressure of an inflammatory focus in the meninges, which was probably peripachymeningitic in origin.

The progressive improvement in the meningeal condition due to Streptococcus haemolyticus, which warranted the hope of recovery until the development of the spinal cord complications, is worthy of more than passing note.

DYSTONIA MUSCULORUM DEFORMANS

A CLINICOPATHOLOGIC STUDY

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Dystonia musculorum deformans was for some time considered to be a neurosis, a variant of hysteria major. Oppenheim,[1] in 1911, in spite of the lack of pathologic proof, was the first to recognize dystonia as an organic disease of the nervous system. Numerous clinical contributions to this study have been made; a revaluation and recapitulation of these are not necessary for our purpose. For the largest collection of clinical reports of the disease the reader is referred to K. Mendel's[2] work. Histopathologic studies, however, are few; it is questionable whether all the cases are the true degenerative type of dystonia musculorum deformans; some apparently are postencephalitic extrapyramidal disorders with dystonic fragments; some are variants of Wilson's disease or pseudosclerosis, and others are strongly suggestive of chorea.

REPORT OF A CASE

History.—P. F.,[3] a woman, aged 28, born in the United States of Russian Jewish parents, was admitted to the Montefiore Hospital on Oct. 16, 1920. In 1911, when 6 years of age, there appeared twisting involuntary movements and deformity of the right foot. A cast was applied for three months; after its removal the purposeless movements and the deformity increased. Scoliosis appeared soon afterward. In 1912, the irregular, involuntary movements spread to the entire musculature of the body, the feet and head being mostly involved, the hands least. From that time until admission to the Montefiore Hospital the condition changed but little. She never attended school, but received one and one-half years of elementary instruction and learned readily. She could not write, but became adept in

From the Neuropathological Laboratory and Neurological Division of Montefiore Hospital.

Read at the Fifty-Eighth Annual Meeting of the American Neurological Association, Atlantic City, N. J., June 7, 1932.

1. Oppenheim, H.: Ueber eine eigenartige Krampfkrankheit des kindlichen und jugendlichen Alters (Dysbasia lordotica progressiva, Dystonia musculorum deformans), Neurol. Centralbl. **30**:1090, 1911.

2. Mendel, K.: Torsiondystonie (Dystonia musculorum deformans), Monatschr. f. Psychiat. u. Neurol. **46**:309, 1919.

3. Frauenthal, H. W., and Rosenheck, C.: Dystonia Musculorum Deformans with Report of a Case, J. Nerv. & Ment. Dis. **52**:134, 1920.

the use of a typewriter. She was never ill, except for a sore throat at the age of 5. No other member of the family was afflicted with this or with any other neurologic disorder. There was no consanguinity in the family.

Neurologic Examination.—On admission there were constant purposeless movements involving mainly the head, trunk and legs, and to some extent the upper extremities. The muscles showed hypertonicity with occasional hypotonicity, particularly in the forearms. The head was retracted and rotated with the chin to the left (fig. 1 *A*). There were occasional irregular movements in the fingers of both hands. Both arms were flung at times in various directions. There were no movements of the face. The legs were alternately hyperextended and hyperflexed; the feet were in equinovarus position, the right more than the left (fig. 1 *B*). There were marked scoliosis, lordosis and tortipelvis (fig. 1 *A*). The patient could walk with assistance, but with a dromedary gait (fig. 1 *A*). The deformity was increased when she attempted to stand or walk. In efforts to control the purposeless movements she became fatigued and dyspneic, and perspired freely.

Fig. 1.—*A*, retraction of the head and tortipelvis. The patient walked on the dorsal surfaces of the feet. She had a dromedary gait and involuntary movements of the head and upper extremities. *B*, deformity of the feet, right more than the left. *C*, hypertrophy of the muscles of the upper extremities and atrophy of the lower extremities below the knees, especially on the right side. This picture and *A* were taken at a later date than *B*.

The muscles of the upper extremities were hypertrophied; those of the lower extremities were conspicuously wasted, especially on the right side (fig. 1 *C*). The reflexes of the upper and lower extremities were present, but were difficult to elicit on account of the excessive movements. There was no Babinski or allied sign. There were no sensory disturbances, except for constant subjective paroxysmal pains in the extremities. During sleep all movements ceased. Under anesthesia there were complete relaxation of the muscles and dissolution of the deformities. Mentally the patient was alert and clear, except toward the end, when she became drowsy and dull.

Course.—During the stay in the hospital, both the hyperkinesis and the deformities progressed so that the patient became bedridden in 1925. In April, 1922, she

complained of dizziness and nausea. Attacks of vomiting occurred one year later, at irregular intervals of from a week to a month, and lasted for two or three days. In February, 1928, these attacks resembled migraine and consisted of severe headache, vomiting, blurring of vision, "green flashes" of light and drooping of the eyelids, followed by severe pain on the right side of the neck, and were attended by intense mental depression. Owing to the generalized painful spasm and migraine, the patient was given small doses of morphine in October, 1928. Two years later, this medication was increased to 0.065 Gm. six times daily. Bronchopneumonia developed on June 27, 1931, and the patient died two days later.

Laboratory Data.—Roentgen examination disclosed marked scoliosis of the lower cervical, entire thoracic and upper lumbar spine. In 1927, fluoroscopy, after a barium meal, revealed marked contractions of the walls of the stomach, with slight regurgitation of the barium into the esophagus. The obstruction to the flow of barium appeared to be due to muscle spasm. The fluoroscopic observations were part of a study carried on on patients with dystonia by Kaufman, Savitsky and Fried.[4] All other laboratory findings were negative.

The clinical and anatomic diagnosis was dystonia musculorum deformans, atelectasis and bronchopneumonia of both lower lobes.

Necropsy.—Gross examination: A complete examination was performed. With the exception of the central nervous system, only the important findings in the other organs will be given. The muscles of the shoulder girdle and arms were hypertrophied. There were a slight amount of atrophy of the muscles of the thigh, which was more marked on the left, and marked atrophy of the muscles of the calves. The lower lobes of both lungs presented a bronchopneumonia. The liver was not enlarged.

Microscopic Examination.—There was fragmentation of the muscle fibers of the heart; the cross-striations were indistinct in places. The liver cells contained a large amount of granular brown pigment. The muscle fibers of the upper extremities were well developed, and there was an increase in the nuclei of the sarcolemma. The muscles of the lower extremities presented hyalinized muscle fibers, loss in the identity of the individual muscle fibers and chains of rod-shaped nuclei, from 10 to 12 in a row.

Pathologic Changes in the Central Nervous System.—Gross Examination: The brain appeared normal. It was cut coronally. There was slight shrinkage of the left putamen and caudate. The cut surfaces were pale. The spinal cord, except for a slightly thickened and hemorrhagic dura, showed nothing abnormal.

Sections from the various convolutions, basal ganglia, midbrain, cerebellum, medulla oblongata and spinal cord were stained by the myelin sheath (Weil modification), cresyl violet, van Gieson, Mallory phosphotungstic, Turnbull's iron blue and Bielschowsky (Kernohan modification) methods. The blocks from the rostral end of the neostriatum to the caudal end of the medulla oblongata were cut serially. A block in the region of the anterior third of the left caudate and globus pallidus and sections from the various convolutions and from the spinal cord were cut by the freezing microtome and stained by the myelin sheath (Weil modification), sudan IV, Cajal gold sublimate (Globus modification), silver carbonate for microglia and oligodendroglia (Penfield modification) and Bielschowsky methods.

Microscopic Examination: Cerebral Hemispheres. The frontal, temporal and occipital convolutions, except for occasional "falling out" and poorly stained ganglion cells, showed nothing of note.

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4. Kaufman, M. R.; Savitsky, N., and Fried, J. R.: Dystonia Musculorum Deformans of Encephalitic Etiology, Arch. Neurol. & Psychiat. **20**:824 (Oct.) 1928.

In the postcentral, insular and superior parietal convolutions there were small necrobiotic foci, with iron deposits which stained light blue with Turnbull's iron reaction in the first, second and third layers of these convolutions. These foci were in the vicinity of the small capillaries or of calcified vessels. The necrobiotic areas were surrounded by glia fibers and a few astrocytic cells; compound granular corpuscles were not found. Several vessels of the third and fifth layers showed beginning calcification. The architectural layers were well preserved, but there was an occasional "falling out" of the ganglion cells, with poorly staining Nissl substance. A number of the ganglion cells of the third layer showed loss in Nissl substance, neuronophagia, satellitosis and deposition of iron granules (fig. 2). Lipoid deposits in the nerve and glia cells were observed in the sections stained for fat.

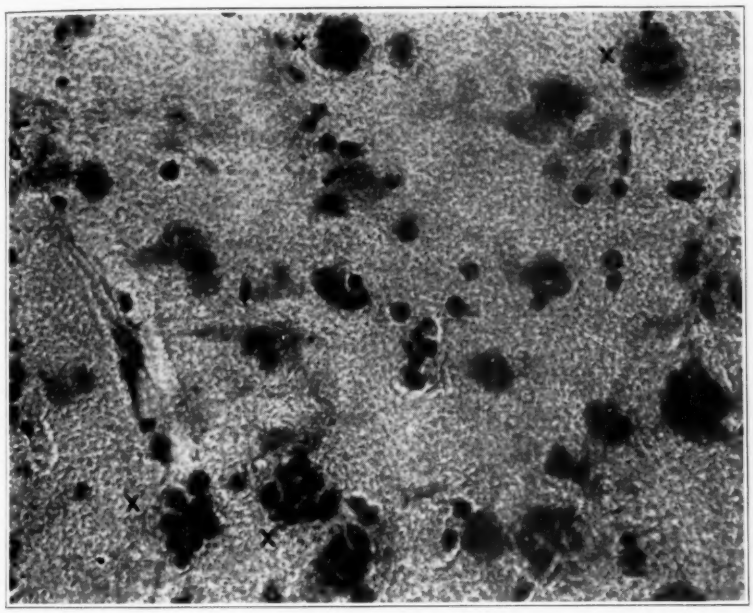

Fig. 2.—Ganglion cells from the superior parietal convolutions, showing neuronophagia at *x*; the other ganglion cells stained poorly. Cresyl violet stain; × 240.

The orbital, inferior parietal and angular gyri, except for small foci of iron deposits in the first and second cortical laminae and a few calcified vessels, were normal.

Basal Ganglia. Sections through the anterior third of the neostriatum (caudate and putamen) showed: The left putamen appeared somewhat smaller than the right; this, however, may have been due to unequal cutting. When compared with normal sections, the fibers of the putamen were fewer in number and took the myelin sheath stain poorly; this was more noticeable on the left. The caudate fibers stained better than did those of the putamen. The large ganglion cells, especially of the putamen, were decreased in number (fig. 3). In these sections three or four large ganglion cells were found per low power field, instead of from 8 to 12 as in the normal, or from 6 to 8 in parkinsonism. Both the large and the small ganglion cells stained poorly and had little Nissl substance; the nuclei

were at the periphery. Some of the larger ganglion cells were swollen. A number of the large and small ganglion cells also showed neuronophagia (fig. 4). In the left caudate neuronophagia was more marked, and the large ganglion cells also disclosed marked chromatolytic changes. The small vessels of the caudate and putamen were increased in number. There was an increase in the glia cells, the microglia predominating. Small focal areas of necrobiosis filled with iron deposits (figs. 5 and 6) were present in the caudate and putamen; these were most numerous in the anterior third and on the superior border of the right putamen; some were found in the vicinity of blood vessels. In these areas the ganglion cells had disappeared; the periphery of some of the necrotic areas showed attempts at gliosis. Many ganglion and glia cells of the striatum contained fine iron granules. A number of the small vessels of the caudate and putamen showed beginning calcification (fig. 7). In sections stained with sudan IV, fat globules were seen in the walls

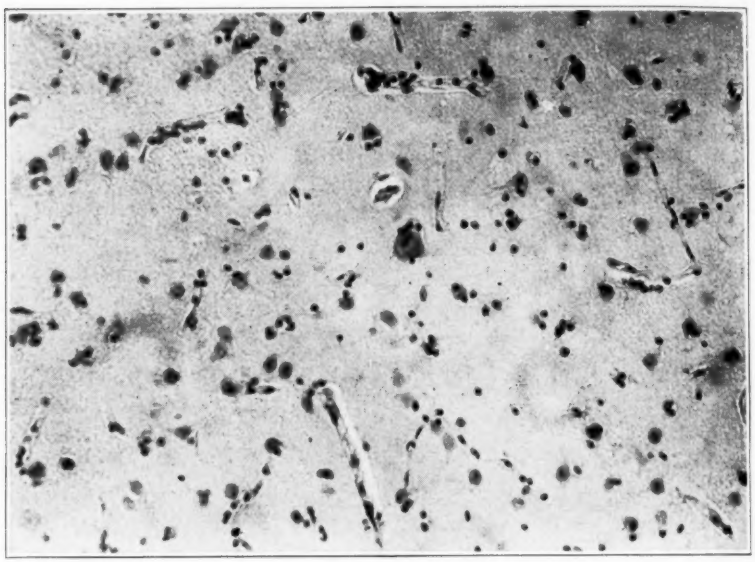

Fig. 3.—Scantiness of the large and small ganglion cells in the putamen. Notice the poorly stained small ganglion cells. Cresyl violet stain; reduced from × 240.

of the vessels and in the ganglion cells; fat deposits completely replaced some of the destroyed ganglion cells. The claustrum, in the same sections, showed no abnormality. The fibers of the corpus callosum and the internal and external capsules were normal.

Sections through the middle of the neostriatum, anterior third of the globus pallidus and amygdaloid nuclei showed: The caudate and putamen presented the same poverty in striatal fibers as in the previous sections; this was more marked in the superior part of the left putamen. The ganglion cells of the putamen and caudate showed the same changes, though not quite so marked, as did those in the anterior third. The superior part of the right putamen contained fewer ganglion cells than did the inferior part. The ganglion cells of the pallidum and thalamic and tuber nuclei were normal. Iron deposits, however, were found in the thalamus and in the nuclei of the tuber cinereum.

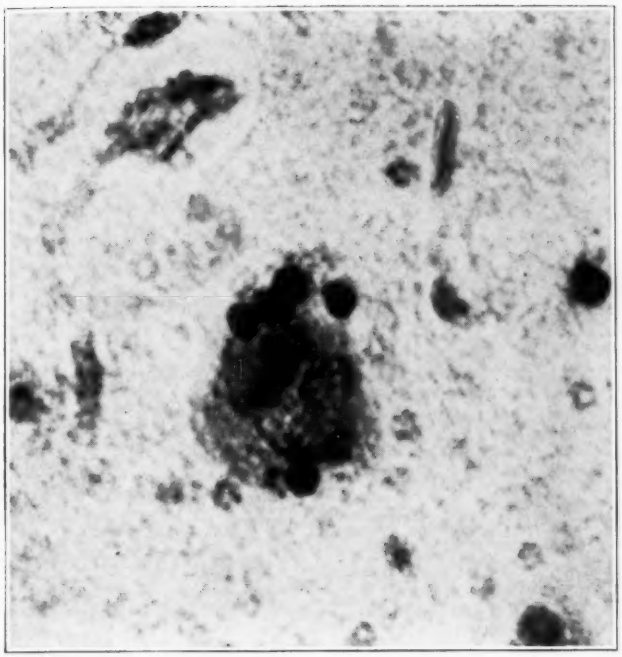

Fig. 4.—Large ganglion cell of the putamen, showing loss in outline and beginning neuronophagia. Cresyl violet stain; × 960.

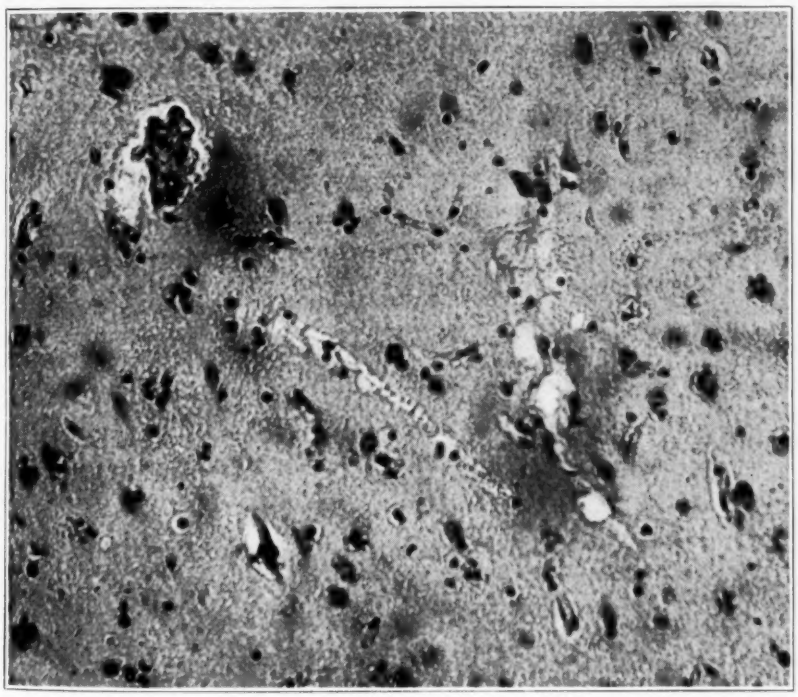

Fig. 5.—Necrobiotic areas in the putamen. Cresyl violet stain; × 240.

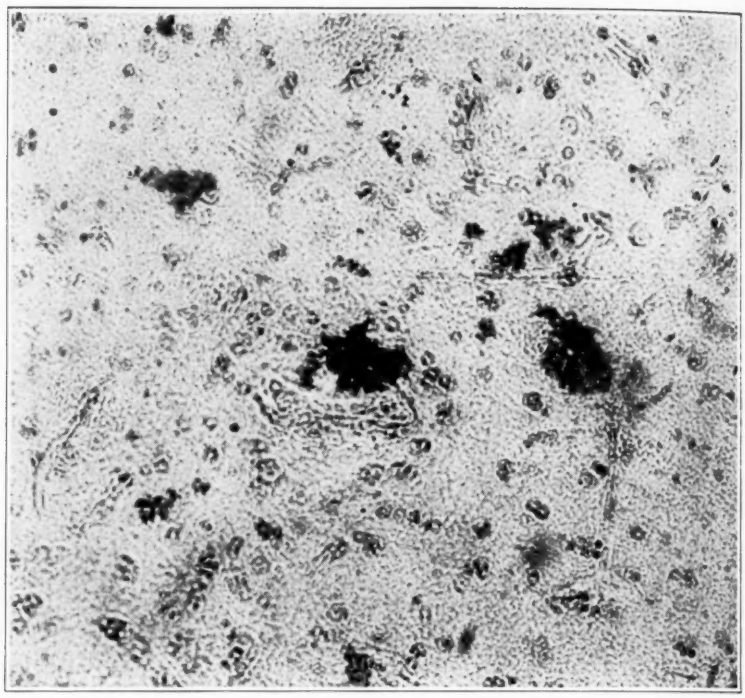

Fig. 6.—Iron deposits in the necrobiotic areas as well as in the glia and ganglion cells. Turnbull's iron blue stain; × 240.

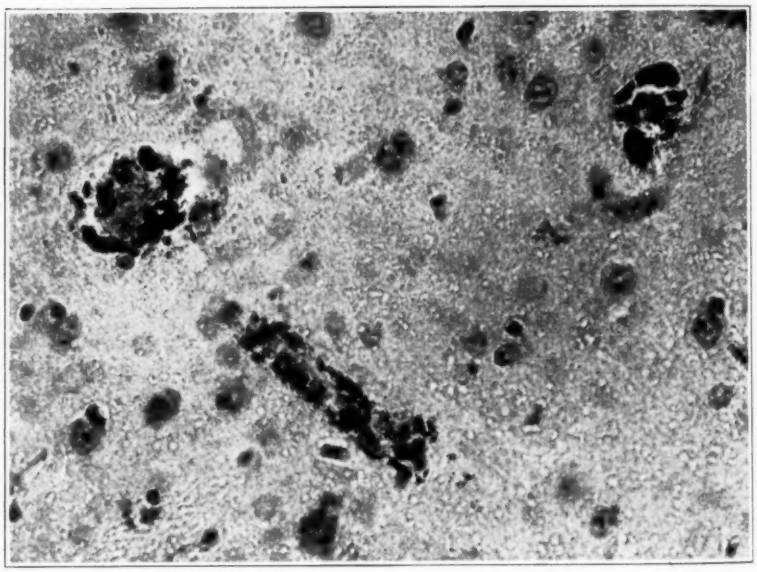

Fig. 7.—Calcium deposits in the walls of the vessels of the neostriatum (putamen and caudate). Notice the poorly stained ganglion cells. Cresyl violet stain; reduced from × 240.

The amygdaloid nuclei showed iron deposits and occasional calcified vessels. The ganglion cells had undergone complete chromatolysis and neuronophagia. As in the putamen, the ganglion cells were decreased in number. A number of the ganglion cells, stained by the sudan IV method, showed marked accumulation of fat and eccentric nuclei (fig. 8).

Sections through the mammillary bodies, globus pallidus and anterior part of the corpus luysi showed: The fibers of the neostriatum and of the corpus luysi were poorly stained. This was especially true of the capsule of the corpus luysi. The fasciculus lenticularis (H_2) and ansa lenticularis were normal. The ganglion cells of the neostriatum (caudate, putamen and amygdaloid nucleus) showed the same changes as in the previous sections.

Midbrain. Sections through the red nucleus, posterior commissure and third nerve nuclei showed: In some sections the corpus medianus luysi was seen on

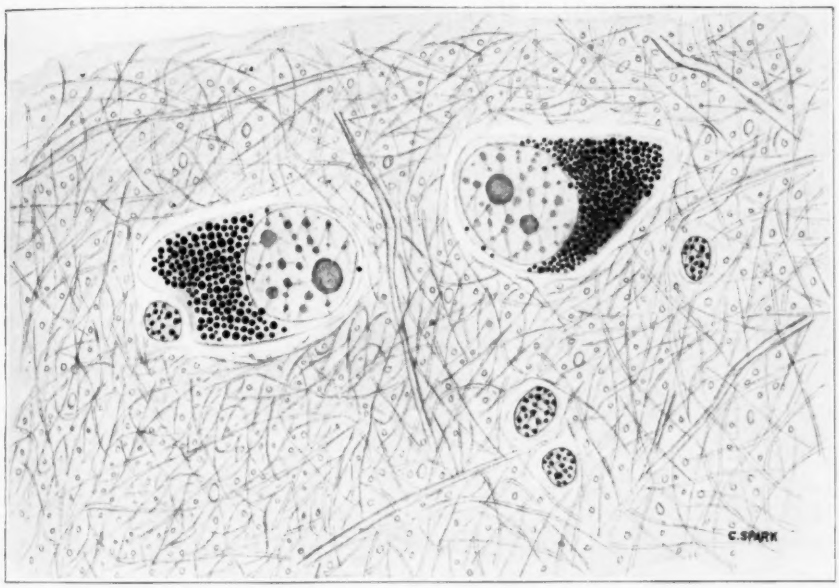

Fig. 8.—Deposition of lipoid and eccentricity of the nuclei in the ganglion cells of the amygdaloid nucleus. Oil immersion; reduced from × 1,000 (camera lucida drawing).

the left side. The ganglion cells of this nucleus did not stain as well as did the ganglion cells of the rest of the pulvinar. Most of them showed barely any Nissl substance; others had undergone complete chromatolysis and neuronophagia. A few necrobiotic areas with iron deposits were present in this area. The ganglion cells of the red nucleus, substantia nigra and geniculates were normal. The ganglion cells of the lateral nuclei of the third nerve were poor in Nissl substance and showed marked vacuolization (fig. 9*A*), destruction and occasional neuronophagia; those of the medial nucleus and of the Edinger-Westphal nuclei were not involved (fig. 9*B*).

Sections through the geniculates, posterior commissure and fourth nerve nucleus showed: The ependyma of the right lateral ventricle near the caudate was thick-

ened and presented a few ependymal outgrowths. The ganglion cells of the nucleus of the fourth nerve disclosed the same type of vacuolization as those in the third nerve nucleus. The ganglion cells of the other nuclear masses were normal.

Pons. The ganglion cells of the motor fifth, sixth and seventh nuclei showed vacuolization, chromatolysis or complete destruction.

Cerebellum and Medulla Oblongata. Sections in the region of the dentate nuclei, cerebellum and medulla oblongata through the end of the fourth ventricle showed:

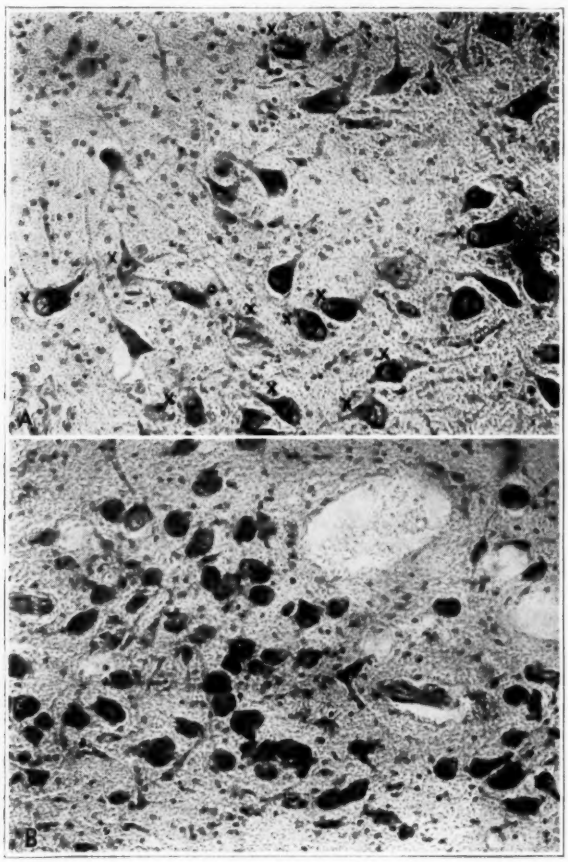

Fig. 9.—*A*, vacuolization of the ganglion cells (*x*) of the lateral nucleus of the oculomotor nerve. Cresyl violet stain; reduced from × 240. *B*, the ganglion cells of the medial nucleus were not involved. Cresyl violet stain; reduced from × 240.

All the fiber tracts stained well. The ganglion cells of the twelfth nerve nucleus and of the nucleus ambiguus showed the same changes as those of the third, fourth, motor fifth, sixth and seventh nerve nuclei. The ganglion cells of the nuclei dorsalis vagi were decreased in number, and a few showed poor Nissl substance, but they were not vacuolated. All the other nerve cells of the medulla oblongata and of the cerebellar cortex were normal. The nerve cells of the dentate nuclei

were swollen and pigmented, and had a homogeneous appearance with very little Nissl substance and eccentric nuclei. No vacuolization was found. The glia nuclei were slightly increased in number. With the sudan IV stain some of the dentate ganglion cells showed a larger accumulation of fat than is seen normally.

Section of the medulla oblongata through the eleventh and twelfth nerve nuclei showed: There was vacuolization of the ganglion cells of both these nuclear masses.

Iron deposits were not found in sections through the pons, cerebellum and medulla oblongata.

Spinal Cord. Sections from the cervical, dorsal and lumbar regions were studied. With the myelin sheath stain, all fiber tracts appeared normal. The central canal was patent throughout. Cresyl violet sections of the spinal nucleus

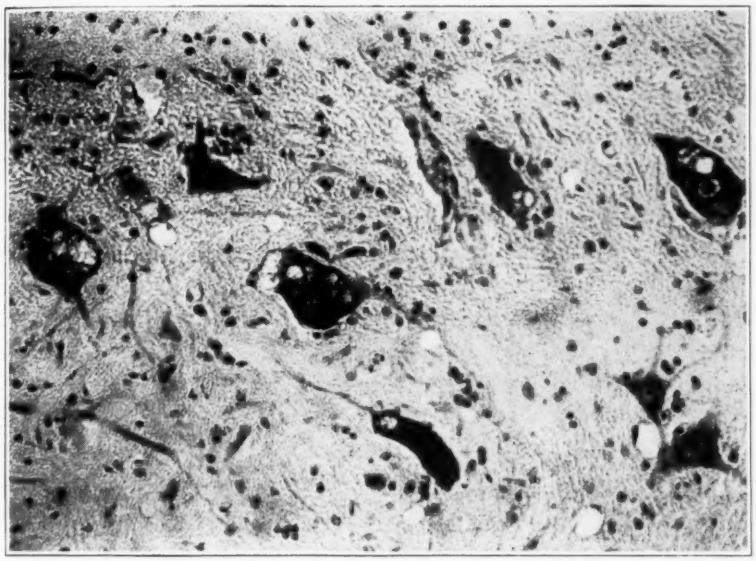

Fig. 10.—Anterior horn cells from the spinal cord, showing vacuolization and pyknosis. Cresyl violet stain; reduced from × 240.

of the spinal accessory nerve, the anterior horn cells of the cervical region in the dorsolateral group, the ventrolateral group and some of the cells of the central cell columns revealed a high degree of vacuolization (fig. 10). Some of the ganglion cells were completely destroyed, and in others the Nissl substance was disintegrated, part of it being collected at the periphery of the cells. The ganglion cells of the mesial group were well preserved.

In the middorsal region, the ganglion cells of the dorsomesial and ventromesial columns presented the same changes as in the cervical region, but were not quite so pronounced. In the lower dorsal region (twelfth dorsal segment) the ventromesial cell columns showed marked vacuolization (fig. 10). The ganglion cells of Clarke's column were normal, except for poorly stained Nissl substance. In the lumbar region, the dorsolateral, intermediate dorsolateral, intermediate and ventrolateral cell columns showed the same marked changes as have been described in the cervical and dorsal regions. The vacuolization was most intense in the anterior

horn cells of the lumbosacral region. The splanchnic lateral cell columns were spared. In sections stained with sudan IV there were large accumulations of fat in the ganglion cell groups enumerated (fig. 11). In Bielschowsky preparations the vacuoles contained argentophile substance.

Sympathetic System: The ganglion cells of the myenteric plexus in the esophagus and cardiac end of the stomach were disintegrated and showed loss of Nissl substance. The cells of the celiac plexus were poor in chromatin.

Summary.—Clinically, a woman of Russian Jewish parents had all the symptoms and signs of the degenerative type of dystonia musculorum deformans. There was no history of encephalitis. Wasting of the muscles of the lower extremities was present. In addition to the dystonia, about three years before death there developed severe head-

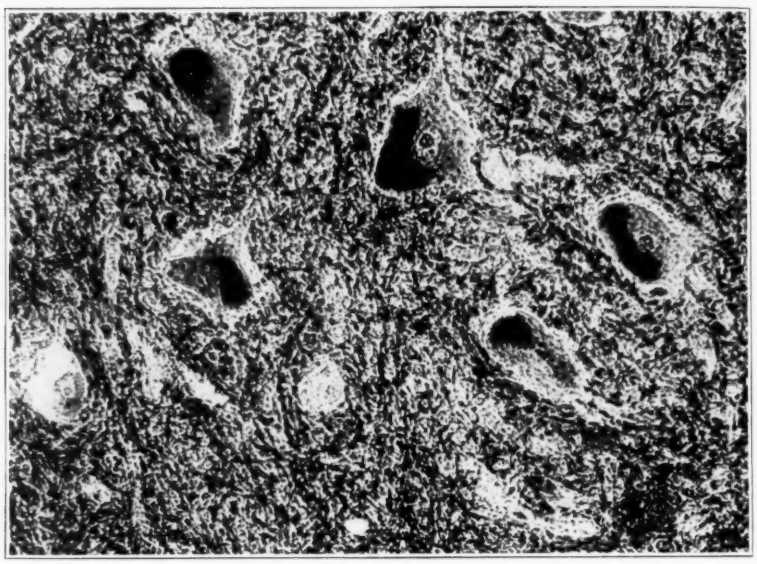

Fig. 11.—Same as figure 10, showing lipoid deposits. Sudan IV stain; reduced from × 240.

ache, vomiting, blurring of vision and drooping of the eyelids; this in many respects resembled migraine.

Histopathologically, the lesions were scattered throughout the central nervous system. The outstanding pathologic changes, however, were in the postcentral, superior parietal and insular convolutions, in the neostriatum and in the ganglion cells of the third (lateral nuclei), fourth, fifth (motor only), sixth, seventh, ninth, tenth (nucleus ambiguus only), eleventh and twelfth cranial nerve nuclei, and in the anterior horn cells.

The changes in the cerebral cortex consisted of: loss in Nissl substance, satellitosis, neuronophagia, iron granules and lipoid deposits in

the ganglion cells, necrobiotic areas with iron deposits and calcified vessels in the insular, postcentral and superior parietal convolutions (fig. 2).

There were poverty and paleness of the white fibers of the putamen. The large ganglion cells of the neostriatum (putamen and caudate) were decreased in number, stained poorly and contained lipoid pigments. There was also neuronophagia of the large and small ganglion cells of this structure (figs. 3 and 4). The blood vessels and ganglion cells of the neostriatum showed an increase in fat deposits; some of the ganglion cells were completely replaced by fat. The smaller vessels of the neostriatum were increased in number, and some were calcified (fig. 7). There was an increase of the glial elements, the microglia predominating. Necrobiotic areas with iron deposits and "falling out" of ganglion cells were present (fig. 6). The amygdaloid nucleus, which is considered by some to be part of the neostriatum, presented essentially the same changes as did the caudate and putamen. The globus pallidus was relatively spared. The corpus luysi showed poorly stained fibers and a poorly developed capsule. In a section through the substantia nigra and red nucleus, the fasciculus lenticularis (H_2) was slightly reduced in size. Occasional areas of necrobiosis with iron deposits were also present in the thalamic nuclei. The cerebellum was normal, except for the ganglion cells of the dentate nuclei, which stained poorly and contained fat deposits, more than are normally seen.

The ganglion cells of the cranial motor nerve nuclei and the anterior horn cells showed essentially vacuolization and chromatolysis (figs. 9 *A*, 10 and 11).

COMMENT

Undoubtedly some of the histopathologic changes described played no part in producing the dystonia. The slight changes in most of the convolutions, except for the parietal (postcentral and superior parietal) and convolutions about the island of Reil, are little stressed, because of the frequency with which such changes may be encountered agonally.

We are somewhat at a loss to explain the destruction and vacuolization of the ganglion cells of practically all the motor cranial nerve nuclei and of the anterior horn cells. Vacuolization of ganglion cells is at times observed following high fever, extreme exhaustion and intoxications, also in edematous brains and in the brains of patients who have had bulbar paralysis; it may also be due to technical defects in the fixation of the tissue. A selective process such as this, in which only the motor nerve cells of the cranial nerve nuclei and of the anterior horns are affected, is, so far as we know, not recorded in the literature. Slightly analogous cases are those described by Urechia, Mihalescu and

Elekes,[5] who found changes in the nerve cells of the nuclei of the ninth, tenth and eleventh cranial nerves, and Schmitt and Scholz,[6] who demonstrated pigment atrophy in the ganglion cells of all the cranial nerve nuclei and anterior horn cells of the spinal cord. Furthermore, the vacuolization in this case was somewhat different from the agonal type; the vacuoles, when stained with the silver preparation, contained argentophile substances. In drawing conclusions as to vacuolization, care must be exercised, for even in normal persons one sees here and there vaculoated ganglion cells. Our patient had neither prolonged agony nor bulbar paralysis. The bronchopneumonia to which she succumbed lasted only two days. Defects in tissue fixation or other errors in histologic technic we feel certain were eliminated. The selectivity of the process, affecting only the motor group of nerve cells, also speaks against this.

Our patient received morphine for about three years before death. We are aware that in severe cases of morphine or other drug intoxications vacuoles may appear in nerve cells. We would again emphasize, however, the presence of vacuolization only in certain motor nerve cells. The greatest changes in the anterior horn cells were those in the lumbar region; these corresponded with the atrophy of the muscles of the lower extremities supplied by that group. Atrophy of muscles in dystonia has been described by Keschner[7] and others. The pathologic changes in the ganglion cells of the motor cranial nerve nuclei and anterior horns may perhaps be considered as exhaustion phenomena due to the excessive involuntary movements. In spite of all these considerations, we are not prepared to accept the alterations in the enumerated motor nuclei as part of the essential pathologic picture of dystonia; these lesions probably are chance associations, the cause of which we are unable to explain.

The iron deposits in the glia cells, ganglion cells and necrobiotic areas of the neostriatum, parietal lobe and convolutions about the island of Reil, and less extensively in other regions are of some significance. Spatz[8] demonstrated that the iron pigment in certain centers of the nervous system is physiologic in the human adult.

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5. Urechia, C. I.: Mihalescu, S., and Elekes, N.: Contribution anatomoclinique à l'étude de la dystonie lenticulaire (spasme de torsion), Rev. neurol. **32**:177, 1925.

6. Schmitt, W., and Scholz, W.: Klinischer und pathologisch-anatomischer Beitrag zur Torsiondystonie, Deutsche Ztschr. f. Nervenh. **126**:53, 1932.

7. Keschner, M.: Dystonia Musculorum Deformans, J. Nerv. & Ment. Dis. **47**:103, 1918.

8. Spatz, H.: Ueber den Eisennachweis im Gehirn besonders in Zentren des extrapyramidal-motorischen Systems, Ztschr. f. d. ges. Neurol. u. Psychiat. **77**:261, 1922.

The iron deposits in the necrobiotic areas in our case consisted of fine granules. The same granules could also be demonstrated with a higher power lens intracellularly in glia and ganglion cells. That these deposits are an expression of a pathologic and not a physiologic state seems likely because of (1) the excessive amount and (2) the location of the deposit. According to Spatz,[8] the deposition of iron pigment in our case would be not hematogenous, but autogenous, that is, part of the metabolism of the cells.

From the pathologic changes observed in extrapyramidal disorders in man, as well as from the results of animal experimentation, Spatz concluded that the globus pallidus, substantia nigra, nucleus ruber, nucleus dentatus, neostriatum and corpus luysi are the most important members of the extrapyramidal motor system and subserve a general function, the regulation of muscle tonus. The last three of these are the centers most affected in our case, if we discount the minor changes in the frontal, temporal and occipital convolutions, as well as the extensive alterations in the motor ganglion cells.

The changes in the postcentral, superior parietal and insular convolutions, neostriatum, amygdaloid nucleus and nucleus medianus luysi had almost a uniform histopathologic picture. The amygdaloid nucleus should not be listed separately, for comparative anatomic and embryologic studies have shown that it is part of the neostriatum. The paleness of the fibers of the body and the shrinkage in the capsular fibers of the corpus luysi may be considered as a descending degeneration of the fibers from the neostriatum to the corpus luysi. The globus pallidus, substantia nigra and red nucleus remained intact.

A review of the cases in the literature would seem to show that in most of them the distribution of the lesion was not limited to the extrapyramidal (striopallidal) system. Wimmer's patient [9] had lesions also in the cerebellum, thalamus, hypothalamus, frontal lobes and insula. Cassirer and Bielschowsky's case,[10] although only a fragment of dystonia (spasmodic torticollis), also showed involvement of the optic thalamus and cortex. Richter,[11] in addition to the changes in the extrapyramidal structures, found lesions also in the cerebral cortex. In Westphal's case,[12] lesions were also present in the motor cortex.

9. Wimmer, A.: Etudes sur les syndromes extra-pyramidaux: Spasme de torsion progressive infantile (Syndrome du corps strié), Rev. neurol. **37**:952, 1921.

10. Cassirer, R., and Bielschowsky, M.: Halsmuskelkrampf und Torsionsspasmus, Klin. Wchnschr. **1**:53, 1922; Zentralbl. f. d. ges. Neurol. u. Psychiat. **28**:513, 1922.

11. Richter, H.: Beiträge zur Klinik und pathologischen Anatomie der extrapyramidalen Bewegungsstörungen, Arch. f. Psychiat. **60**:226, 1923.

12. Westphal, A.: Ueber doppelseitige Athetose und verwandte Krankheitzustände (striäres Syndrome), Arch. f. Psychiat. **60**:769, 1919.

Urechia, Mihalescu and Elekes,[5] in addition to alterations in the amygdaloid nucleus and striatum, described lesions in the cerebellar cortex, dentate nuclei, olivary nuclei and nuclei of the ninth, tenth and eleventh cranial nerves; slight changes were also observed in the cerebral cortex. Van Bogaert [13] found a tuberculoma of the parietal lobe in a case of torsion spasm; the dystonic phenomena were elicited in upward movements of the eyeballs. Poppi [14] reported changes in the fifth and sixth layers of the frontal lobe and insula. Jakob's first patient [15] had calcification in the putamen, pallidum, thalamus, dentate, pons and part of the cerebral and cerebellar hemispheres. His second patient, in addition to lesions in the substantia nigra, striatum, thalamus and dentate nuclei, had falling out of Purkinje cells of the cerebellum and recent as well as old necrobiotic changes in the cerebral hemispheres, especially in the occipital lobes. His third patient had demyelinization of the pontocerebellar fibers and slight changes in the cerebrum. Schmitt and Scholz,[6] in addition to involvement of the extrapyramidal system, described changes in the ganglion cells of the cerebrum and cerebellum.

The cortex apparently was not involved in the cases described by Thomalla,[16] Marinesco and Nicolesco [17] and Laruelle and van Bogaert.[18]

In view of the findings in our case and those reported by others, we must agree with Wimmer [9] and Wilson [19] that the corpus striatum alone is not responsible for the dystonic phenomena. Evaluation of the pathologic findings other than those in the neostriatum is essential for the understanding of the pathophysiology of involuntary movements occurring in this disease as well as in chorea, athetose doublé, Wilson's disease and pseudosclerosis.

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13. van Bogaert, L.: Observations anatomiques et cliniques de spasmes de torsion, Rev. neurol. **1**:923, 1929.

14. Poppi, U.: Beitrag zur pathologischen Anatomie der Torsiondystonie, Zentralbl. f. d. ges. Neurol. u. Psychiat. **61**:503, 1931.

15. Jakob, A.: Zur Frage der nosologischen und lokalisatorischen Auffassung der torsiondystonischen Krankheitserscheinungen, Deutsche Ztschr. f. Nervenh. **124**:148, 1932.

16. Thomalla, C.: Ein Fall von Torsionspasmus mit Sectionsbefund, Ztschr. f. d. ges. Neurol. u. Psychiat. **41**:311, 1918.

17. Marinesco, G., and Nicolesco, M.: Un cas anatomo-clinique de dystonie contorsive spasmodique avec lésions du striatum et des centres sous-thalamiques, Rev. neurol. **1**:973, 1929.

18. Laruelle, L., and van Bogaert, L.: Etude anatomo-clinique d'un cas de syndrome rigide, avec spasme de torsion, Rev. neurol. **1**:941, 1929.

19. Wilson, S. A. K.: Disorders of Motility and Muscle Tone with Special Reference to the Corpus Striatum: IV. Involuntary Movements and Their Pathogenesis; Chorea and Athetosis, in Modern Problems in Neurology, New York, William Wood & Company, 1929, p. 209; Lancet **2**:1 (July 4); 53 (July 11); 169 (July 25); 215 (Aug. 1); 268 (Aug. 8) 1925.

The cases recorded in the literature raise the question whether they are all true dystonia—the so-called idiopathic dystonia first described by Oppenheim [1] and Ziehen,[20] supposed to occur in people of Jewish extraction. An analysis of the histopathologic findings in these cases reveals that in Thomalla's,[16] Wimmer's [9] and Jakob's [15] (third case) patients there was cirrhosis of the liver; they are therefore perhaps allied to Wilson's disease or pseudosclerosis. Clinically, Richter's,[11] Jakob's [15] (first and second cases) and Schmitt's and Scholz' [6] cases were possibly allied to chorea. In Westphal's [12] patient athetotic movements developed first, and later features suggestive of torsion spasm and paralysis agitans sine agitatione. Laruelle and van Bogaert's [18] patient had had Little's disease prior to the occurrence of the torsion spasm. The incidence of the disease in persons of Jewish extraction is recorded only by Richter,[11] Urechia, Mihalescu and Elekes,[5] Marinesco and Nicolesco [17] and in the present case. Jakob's [15] (second case), Westphal's [12] and Urechia, Mihalescu and Elekes' [5] cases showed histopathologic evidences of inflammation suggestive of some type of encephalitis.

The clinical and pathologic findings in these cases would seem to confirm Wimmer's view that so-called dystonia is not a disease, but only a syndrome. In this syndrome we should include: the heredodegenerative group, consisting of idiopathic dystonia (Cassirer and Bielschowsky,[10] Poppi [14] and Marinesco and Nicolesco [17]) and dystonia allied to Wilson's disease, pseudosclerosis and chorea; the infectious group, possibly sequelae of encephalitis. The dystonia described by van Bogaert [13] caused by a tuberculoma of the frontoparietal region, with sparing of the striopallidal structures, is the only case recorded due to a neoplasm. In accordance with this classification, we should consider our case as an idiopathic dystonia of the heredodegenerative group.

CONCLUSION

A case of idiopathic degenerative dystonia musculorum deformans is described clinically in a patient of Russian Jewish extraction.

Pathologically, the lesions in the postcentral, superior parietal and insular convolutions and in the neostriatum are considered to have played a rôle in the mechanism of the involuntary movements. The pathologic changes in the ganglion cells of the third (lateral nuclei), fourth, fifth (motor), sixth, seventh, ninth, tenth (nucleus ambiguus only), eleventh and twelfth cranial nerve nuclei and in the anterior horn cells are regarded as perhaps mere chance associations; from our present study they do not lend themselves to interpretation.

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20. Ziehen, T.: Ein Fall von tonischer Torsionsneurose, Neurol. Centralbl. **30**: 109, 1911.

DISCUSSION

DR. W. G. SPILLER, Philadelphia: The pathologic findings were widespread throughout the central nervous system in Davison and Goodhart's case, but were chiefly in the postcentral, superior parietal and insular convolutions, neostriatum, amygdaloid nucleus and nucleus medianus luysi. These findings are similar to those obtained in other hyperkinetic disorders, such as Huntington's chorea, Wilson's disease and pseudosclerosis; in all these cortical changes have been described.

In my case of double athetosis, the putamen was greatly degenerated and the pallidum was atrophied on both sides; the Betz cells showed degenerative changes; the hepatic condition was diagnosed as chronic passive congestion, with red atrophy. The body was much distorted by spasticity and contractures. Double athetosis of extreme degree in a chair-ridden patient has a resemblance to dystonia musculorum deformans.

It is striking that in many of the reported cases of dystonia, cirrhosis of the liver was found, although in the case reported by Davison and Goodhart the liver was not enlarged. The case reported by Richter was a combination of chorea, athetosis, tics, hemiballismus and parkinsonism; it shows how the hyperkinetic disorders have a clinical resemblance, yet Richter regarded his case as the only one of true dystonia studied histopathologically.

Davison and Goodhart reject some of the cases reported as dystonia, and take the position that dystonia, Wilson's disease, pseudosclerosis, chorea and double athetosis are possibly variants of corticoneostriatal disorders. This has been my opinion for a long time. In all the cases cited by Davison and Goodhart, except that of Thomalla, lesions were found also in the cerebellum, thalamus and elsewhere, and they believe that the cerebellorubrothalamocortical system plays an important rôle in the hyperkineses. This may well be possible, and it enables one to understand the difficulties in diagnosis. Somatotopic localization within the neostriatum, and I would add within the pallidum also, has appealed to me as well as to others as a possibility, but pathologic findings do not justify it.

DR. ISRAEL STRAUSS, New York: Why did the authors disregard the changes in the ganglion cells of the motor nuclei? If they do not wish to connect them with the syndrome which they are describing clinically, what is their explanation of the occurrence of those changes?

DR. CHARLES DAVISON, New York: Vacuolization of the ganglion cells frequently occurs in extreme degrees of exhaustion, drug intoxication, febrile conditions, defects in fixation and other conditions. Whether the prolonged disease in our patient had anything to do with an extreme state of exhaustion it is difficult to state. A careful review of the literature on the vacuolization of ganglion cells has not shown such an extensive and selective involvement; selective in the sense that only ganglion cells of the motor nerve nuclei were involved.

We do not consider these changes as a part of the dystonia, but as mere chance associations.

Abstracts from Current Literature

THE FATE OF PATIENTS WITH CRANIOCEREBRAL TRAUMA. ALEXANDER PILCZ, Jahrb. f. Psychiat. u. Neurol. **48**:317, 1932.

The author's material is derived from cases that had been observed during and since the World War in the Vienna Kopfschuss-Station (station devoted to the treatment of head injuries received from firearms). He selected at random 1,000 cases of patients who had survived the injury for from thirteen to seventeen years. Of these, 680 had sustained cerebral injuries (by bullets and grenade splinters), and 320 had cerebral concussion with more or less loss of consciousness, basal fractures, etc., without injury to the brain. Some of the patients belonged to both of these groups, and others had received a trauma to the brain or had sustained cerebral concussion on several different occasions during the war. Forty of those with cerebral trauma and 10 with cerebral concussion were dead at the time of this publication; of the former, 9 had survived for from twelve to seventeen years without having had an epileptiform seizure; 13 had seizures, and 18, though free from convulsions during life, did not live sufficiently long after the trauma to enable one to determine with any degree of certainty whether or not they were actually free from seizures. In the cases with cerebral concussion the figures for the corresponding groups were 4, 3 and 3.

Among those who died, the cause of death in the group with cerebral trauma was as follows: brain abscess in 3 cases (two months, three months and two and one-half years, respectively, after the injury; the latter two cases also showed epileptiform seizures, and in 1 case there was a cystic softening in the right occipital lobe which appeared six months after a bullet wound in the temporal lobe); suicide, 1 (in traumatic epilepsy, thirteen years after the injury); severe arteriosclerosis in 3 cases, seven, twelve and thirteen years, respectively, after the trauma (1 of these patients had seizures, and 1 of the cases occurred in a man, aged 26, who had no history and no serologic evidence of syphilis); pulmonary tuberculosis in 11 patients, 3 of whom had seizures; myocardial degeneration in 3 cases (eleven, twelve and fifteen years after the injury; the last patient also had seizures); typhoid fever in 2 cases (four and six years after the trauma, the last an epileptic patient); pneumonia in 2 cases (five and fifteen years after the trauma); purulent sinusitis in 1 case (nontraumatic purulent otitis media nine months after the injury); tuberculous meningitis (one and one-half years) in 1 case; tuberculous spondylitis in 1 case (two years after the trauma); grip pneumonia (two years after the trauma) in 1 case; mediastinal tumor (two and one-half years after the trauma) in 1 case; marasmus and dementia paralytica in 1 case (this patient had contracted syphilis thirteen years before the trauma; at the age of 42 he sustained a bullet wound in the back of the head; three years later definite signs of dementia paralytica developed, and he died nine months later); sarcoma (six years after the trauma) in 1 case; dysentery (seven years after the trauma) in 1 case; carcinoma (thirteen years after the trauma) in 1 case; pleurisy (sixteen years after the trauma) in 1 case; 1 case each of sepsis (four years after the trauma), carcinoma (seven years after the trauma), pulmonary gangrene (eleven years after the trauma) and a fall (nine years after the trauma). The last 4 patients also had seizures at one time or another after the trauma.

In the cases of cerebral concussion, the cause of death was as follows: cystic degeneration in the left lenticular nucleus thirty-three months after the trauma in 1 case, status epilepticus fourteen years after the injury in 1 case, suicide thirteen years after the trauma (these 3 patients had seizures), and purulent meningitis in 1 case (nine months after a fall followed by fracture of the inner plate of the parietal bone). The cause of death in each of the following cases in this group had no relation to the injury: 1 marasmus in a person addicted to morphine

fifteen months after the trauma (this patient was a drug habitué before the accident), 1 sepsis (thirteen years after the trauma), 1 tabes (thirteen years after the trauma), 1 multiple sclerosis (eleven years after the trauma), 1 tuberculosis (four years after the trauma) and 1 encephalomalacia in a man, aged 48, with cerebral atherosclerosis (twelve years after the injury).

At least 312 (31.2 per cent) of the entire 1,000 patients had had convulsions at one time or another. The mortality of those with seizures was much higher than of those without seizures. It is noteworthy that many hard drinkers who had sustained most severe cerebral injuries, with fractured skulls, have thus far remained free from convulsions, whereas others, total abstainers, with seemingly slight injuries to the head, have been suffering continuously from epilepsy. Among the 217 with cerebral trauma and the 95 with cerebral concussion (all of whom are subject to seizures) Pilcz could not find a single case with personality changes of the type ordinarily observed in chronic epileptic persons, although an unusually large number of patients showed abnormal irritability and disturbances in intelligence and memory, which in some cases led to dementia and in others to a traumatic-psychopathic constitution. Only 39 of the 312 epileptic persons were able to continue their previous occupations.

In 217 patients with cerebral trauma and epileptiform seizures, the injury affected the frontal region in 44 cases, the parietal region in 121, the temporal in 29, the occipital in 13 and multiple areas of the skull without fracture in 10. In 286 patients without seizures, the regions affected were: frontal, 55; parietal, 129; temporal, 39; occipital, 48; face, 4, and multiple areas without fracture, 11. Jacksonian convulsions alone or combined with generalized seizures occurred in 42 patients with trauma to the brain; these were distributed as follows: frontal lesions, 5; temporal, 3; occipital, 2, and parietal, 32, or 76.19 per cent. In 95 patients with cerebral concussion and epilepsy there were only 4 who had jacksonian attacks; in 3 of these the site of the trauma to the skull could not be determined, and the fourth case occurred in the patient who died thirty-three months after the injury from a lesion in the left lenticular nucleus.

Among the 217 patients with trauma to the brain who had seizures, 102 had neurologic signs indicative of organic brain disease, whereas of the 286 without seizures only 62 had neurologic signs. Among the former, in 9 patients there developed simultaneously with their cerebral injury a bilateral lesion of the internal ear, and 2 patients who sustained bullet wounds in the occipital region had, in addition to hemiplegia, prolonged visual disturbances. Four other patients with injuries in the occipital region had visual disturbances without paralysis; 11 had only a lesion of the internal ear, and 1 patient with a bullet wound in the frontal region had a lesion in the internal ear and visual disturbances. Among 62 patients with paralyses but without convulsions there were 4 who also had a lesion of the internal ear, and 1, with a bullet wound in the occipital lobe, had in addition visual disturbances. This group also included 16 patients with visual disturbances without paralysis; 12 of these had received bullet wounds in the occipital region; there were 16 patients with only a lesion in the internal ear; there was 1 patient with a lesion of the ear and visual disturbances only (injury to posterior portion of the parietal region), and 1 patient had peculiar prolonged cerebellar symptoms (bullet wound in the posterior part of the skull). Among 95 patients with cerebral concussion and convulsions there were 7 with paralyses, and among 192 belonging to the same group but without convulsions there were 6 with paralyses; in the former there were 3 cases with a lesion of the internal ear, and in the latter, 7 with such lesions. It is also noteworthy that in 1 of the patients, aged 19 years, with cerebral concussion there developed, three months after the accident, epileptiform convulsions and typical attacks of Raynaud's disease in the upper extremities, which would occasionally appear during the convulsions and at other times regardless of the convulsions.

In the entire series of 1,000 cases there were 4 cases with rigid pupils. In 1 of these cases Pilcz could find no record of the biologic findings; this patient received a bullet wound in the temporal region (metal splinters were found in the

temporal lobe); epilepsy developed one year after the injury; during the following fifteen years he presented marked evidences of a severe traumatic-psychopathic constitution but no other signs of neurosyphilis. In the 3 remaining cases with rigid pupils the biologic findings in the blood and spinal fluid were negative; 1 of these has been under observation as a case of war neurosis for twelve years (bullet wound in the temporal region); in another who had received a bullet wound in the left frontal region epilepsy and an Argyll Robertson pupil on the right side soon developed, and the third patient, after having been injured by a grenade, has been under observation for twelve years for general disability and reflex pupillary rigidity.

KESCHNER, New York.

ACUTE ANTERIOR POLIOMYELITIS IN THE CHICAGO AREA IN 1931. SIDNEY O. LEVINSON, CLARICE McDOUGALL and WILLIAM THALHIMER, J. A. M. A. **99**:1058 (Sept. 24) 1932.

Levinson, McDougall and Thalhimer report that, in general, the symptomatology of acute anterior poliomyelitis in the Chicago area in 1931 corresponded with that described in other reports. About one third of the cases were of the dromedary type. The most frequent complaint was headache; nausea or vomiting also occurred with great frequency. A history of sore throat was relatively common, occurring in about 40 per cent. Diarrhea was uncommon, as was frequency of urination. At times there was a marked retention of urine, but this never required catheterization. There was pain of the back, the back of the neck or the extremities in over half the cases. An increased temperature was always present, usually between 101 and 102 F.; the pulse rate averaged 120. A generalized lymphadenopathy was found only a few times; more often there was only a cervical lymphadenopathy, usually associated with a reddened throat. Although the "spine sign" was a frequent and suggestive finding, it was elicited less often than cervical rigidity. Particularly is this true in bulbar polioencephalitis. Another sign that was found in over 50 per cent of the cases seen in the city is the "head drop." This sign is best elicited by placing both hands under the shoulder blades and raising the patient to a sitting posture. The head falls backward and cannot be brought to an erect position by the patient's efforts. The authors have considered this additional sign of value, for it may be present when cervical or back resistance is so slight as to be doubtful. The histories of the most severe onsets of gastro-intestinal upsets and headache have more frequently been associated with the bulbar than with the spinal type of the disease. However, it is not of sufficient constancy to enable one to draw any prognostic conclusions. A tremor was observed in over 50 per cent of the cases but was varied in character. It appears in the preparalytic stage, as a fine or coarse tremor of the extremities, less commonly as an ataxic tremor, and occasionally, in very toxic cases, as a diffuse "shivery" tremor of the body. Perioral pallor was often present. Muscle tenderness was far more frequent than hyperesthesia. Brudzinski and Kernig signs were variable, being found in less than one fourth of the cases. It is important to realize that many of the symptoms, and most of the physical or neurologic signs, may not necessarily be present. Many of the authors' cases did not confirm the finding of a prostration greater than expected with the moderate fever. Of seventy-three "inside" cases, thirty-three showed moderate prostration and ten a severe degree of prostration out of proportion to the hyperpyrexia; thirty cases presented no evidence of any severe illness, and the patients seemed no sicker than could be expected with an infection of the upper respiratory tract. Several patients were free from any neurologic manifestations that could lead one to make a diagnosis of poliomyelitis. Because of the general symptoms, a history of exposure and the season of the year, it was thought that the additional information which could be obtained by lumbar puncture was essential, and only on the positive spinal fluid results was the physician able to make a diagnosis. The spinal fluid pressure, as determined by the drop method, was normal or moderately increased. The usual count was from 50 to 250 cells, the lowest being 4, the highest 740. In all but a few cases there was a predominance of mononuclear cells in the fluid;

when polymorphonuclear leukocytes were more numerous, the case was usually very early. In all cases globulin was increased, determined by the Ross-Jones ring test, saturated ammonium sulphate being used. At times, the ring was slow in forming, but invariably became quite distinct within fifteen minutes. It is extremely difficult to draw any definite conclusions as to the therapeutic efficacy of serum from the authors' limited clinical study. The ideal course of running a control series and making periodic muscle examinations was not available to them. Of sixty-five patients treated in the preparalytic stage there were thirty-four who manifested some degree of paralysis, and the mortality in this subgroup was less than half the mortality in the untreated paralytic group in the city. Furthermore, in none of these cases was the involvement severe, and the total paralysis of this group was almost minimal when compared with a like number made up of the untreated paralytic patients who had the least paralysis. There may have been many cases of nonparalytic poliomyelitis with similarly good results. The validity of such an argument is lessened when it is realized that the physicians were definitely on the alert for cases of poliomyelitis, and, whenever suspicious, they notified the Serum Center. The authors think that the clinical reaction to the serum should be stressed. There were many patients treated who showed such a prompt and favorable response within twenty-four hours, a temperature drop to normal and complete subsidence of symptoms and signs (except for some increased neck rigidity following spinal serum administration), that it seemed almost specific, as shown in the accompanying charts. This response was most striking when it occurred in patients treated within twenty-four hours of the onset of symptoms, cases that would ordinarily be expected to run several days before convalescence. This clinical improvement, following shortly after serum therapy, seemed quite significant, even though it did not always occur. Although unable to ascertain the precise value of convalescent serum, the authors feel justified, from the results they obtained, in recommending the combined therapy of convalescent serum in preparalytic poliomyelitis at the earliest possible moment. Cases of encephalobular poliomyelitis must be individualized. The patients who are so severely prostrated that even the manipulation attending a lumbar puncture might be hazardous should receive serum only intravenously. The remainder may be treated by the combined method. The value of serum therapy in patients already paralyzed is questionable and debatable. When a surplus of serum is at hand, it can be used for the problematic benefit in arresting an apparently extending paralysis. Since it is almost impossible to secure a surplus of convalescent serum, pooled serum from normal adults should be used, for the latter can be obtained with ease, and experimentally its use is as logical as is that of the convalescent serum. Until more rational and effective therapy is advanced, treatment with convalescent or normal adult serum should be continued.

EDITOR'S ABSTRACT.

NOBEL PRIZE IN MEDICINE FOR 1932 AWARDED TO SHERRINGTON AND ADRIAN. EDITORIAL, J. A. M. A. **99**:1693 (Nov. 12) 1932.

The Nobel Prize in medicine for 1932 has been awarded to two British investigators, Sir Charles Scott Sherrington, professor of physiology at Oxford University, and Dr. Edgar Douglas Adrian, professor of physiology at Cambridge University. The honor bestowed on Professor Sherrington is a belated recognition, by the Nobel Prize Committee, of his many monumental contributions to knowledge of the physiology of the nervous system made during the past forty years. Early in his career he mapped out the motor area of the cerebral cortex of the chimpanzee, thus establishing the character of cerebral localization of function. Another important discovery made by him was that of decerebrate rigidity — an extensor hypertonus of the legs of a mammal following the section of the brain stem just above the pons. This discovery led to the epoch-making work of Magnus and his associates in body righting and postural reflexes. Professor Sherrington is perhaps best known for his thorough-going study of the reflex equipment of the "spinal" mammal, in which he discovered the phenomenon of "reciprocal innervation," a reflex relaxation of one muscle or set of muscles simultaneously

with the contraction of another group of muscles, the two groups constituting anatomic antagonists. Thus, flexors and extensors, instead of working against each other, actually are made to work together in the execution of both flexion and extension, which results in the movements being carried out with a greater degree of exactitude than would be possible by the action of one group alone. His work on the spinal mammal was reported in a series of lectures given at Yale University and published in 1906 under the title "Integrative Action of the Nervous System," which has become one of the classics of physiologic research. That other scientific bodies were not so tardy in recognizing Professor Sherrington's accomplishments is shown by his election to the presidency of the Royal Society, his membership in many foreign scientific societies, including the National Academy of Science at Washington, and the bestowal on him of honorary degrees by seventeen universities.

Adrian's researches began on the isolated peripheral nerve. At first, with Lucas, he clarified much of the behavior of nerves in transmitting crucial messages. The index of a propagated nerve impulse was here the contraction of an attached muscle and failed to discriminate the action of an individual axon from the total. With the advent of a practical amplifying technic, however, the nerve action current could be studied with a precision not before possible, and Adrian utilized these in his further analysis. Single nerve fibers were activated by normal stimulation of single end-organs, or after destruction of the connections of all but one. Detailed information on mechanisms of sensory stimulation rapidly resulted, and the general relationship, that stimulus intensity is reflected in afferent impulse frequency, clearly emerged.

One of the first fruits of Sherrington's later approach was the delineation (in cats) of the myotatic, or stretch, reflex, not unrelated to his earlier discovery of decerebrate rigidity. Pull on the tendon of a muscle led to reflex shortening in response to continued tension, as in posture and tone of antigravity muscles. Adrian obtained his first success with single end-organs by pulling a frog's muscle and recording the volley set up in a single afferent fiber. These studies resulted in a clearer picture of reflex tone that helped to settle the cloudiness of conceptions of this problem. Many clinical neurologists as well as physiologists have been interested in this work, for spasticities contribute greatly to human invalidism. Neurologists have followed his work with their own researches on the disturbances in tone mechanism appearing in disease.

The discharge of motor neurons also was investigated by the electrical and mechanical technics, and complementary information was obtained. The occurrence of distinct, spontaneous and rhythmic changes in electrical state and irritability of ganglion cells was an important observation. It cannot fail to be of profound significance that receptor organs and nerve cells and, barring striking quantitative differences, the nerve fiber itself have been shown to function on the same simple plan. Professors Sherrington and Adrian have made significant additions to knowledge of the dynamics of the normal nervous system, a knowledge that is basic for diagnosis and therapy in nervous disorders.

EDITOR'S ABSTRACT.

PRINCIPLES OF TREATMENT IN COMMON ARTERIAL DISEASES OF THE EXTREMITIES. W. J. MERLE SCOTT and JOHN J. MORTON, J. A. M. A. **99**:982 (Sept. 17) 1932.

Scott and Morton believe that in the common arterial diseases of the extremities treatment should always be directed first toward preventing the ischemia from doing more harm than necessary. This is a general principle and applies to all cases irrespective of their cause. Under this heading come such simple but important measures as rest, postural treatment and exercise, relief from pain and, particularly, scrupulous prophylaxis against infection. The choice of other measures, however, depends on the presence or absence of spasm. When occlusion is shown by a functional test to be the causative factor, then at the time there is no way to augment greatly the diminished flow of blood to the extremity. In such cases, the principle of treatment is to aid the more peripheral distribution of the small amount of arterial blood available. The authors have found venous

ligation to be the most valuable procedure for this purpose. This is no panacea in the treatment in this group of cases, but it appears to be of benefit in cases in which the circulation is not hopelessly inadequate. On the whole, however, the prognosis in this group is much poorer than when there is a large element of spasm. In the latter group, the most important principle of any treatment adopted is to overcome, either temporarily or permanently, the arterial spasm. Various methods to accomplish this purpose have been used. Among them are, particularly, sympathetic denervation, either at the level of the chain or in the peripheral nerves, fever-producing injections, local or general hyperthermia and the use of vasodilating drugs. The more conservative measures, such as the use of drugs and of local heat, have proved unsatisfactory for effective control of arterial spasm. The immoderate use of tobacco has long been suspected clinically of being detrimental. Coller has recently shown that it causes definite vasoconstriction. Certainly tobacco should be denied these patients, at least in excess. This prohibition, even when carried out by the patient, is not sufficient to overcome the vasospasm already present. Vasomotor denervation of the lower extremity by lumbar sympathetic ganglionectomy produces a continuous improvement in the local circulation to the same degree as was caused temporarily by the test with local anesthesia. This operation is the procedure of choice in the young or middle-aged adult when the clinical evidence of a local circulatory deficiency and the functional importance of vasoconstrictor spasm are clearly established. The one important objection to this form of treatment is that it requires a major operation. The peripheral vasodilatation accompanying the systemic reaction to the injection of protein or inorganic chemicals has been advocated as a method of treatment in the milder cases in place of surgical intervention. The effect lasts from a few hours to several days. This method would be useful as a substitute for operation in the older group of patients concerning the condition of whose myocardium there may be some doubt. It is exactly in these cases, however, that the dangers of such reactions become greater. Consequently, it does not help in the more difficult decision as to the method of choice for overcoming spasm. For these cases, paravertebral injections of alcohol have been advocated. This procedure probably does not give permanent relief; it is usually followed by rather severe neuritic pains, and would make a later operation, if necessary, much more difficult. Periarterial sympathectomy does not have sufficient merit to warrant its use in such cases. Injection of alcohol into the peripheral nerves below the main muscular branches not only relieves pain, but may result in improvement in the local circulation when the latter is impaired by vasoconstrictor spasm. The two objections to this method of accomplishing the latter purpose are: First, anesthesia in the peripheral area accompanies the vasomotor paralysis. Second, vasoconstrictor innervation to the vessels is reestablished in a few months. This method, however, is helpful in some difficult cases when operation and fever-producing injections are absolutely contraindicated by the patient's condition. The one procedure that permanently overcomes the detrimental effects of sympathetic vasoconstriction in arterial disease is sympathetic ganglionectomy. We hope some day to have a simpler method of removing as satisfactorily arterial spasm in the extremities.

EDITOR'S ABSTRACT.

SOME FEATURES OF GLIOBLASTOMA MULTIFORME. E. M. DERRY, Bull. Neurol. Inst., New York **2**:157 (July) 1932.

The authors present a critical study of certain features of the growth of glioblastoma multiforme based on the study of ten consecutive cases. The brains containing these tumors were sectioned after hardening so that four large radial blocks were cut and numbered according to a uniform system, which provided radial samples of the tumor from its center out to and including what appeared macroscopically to be normal tissue beyond the growth. Particular emphasis is placed on the study of the overgrowth of vascular elements. The authors found the following general conditions of tissue reaction: (*a*) a central section characterized by necrosis, bordered by (*b*) an area characterized by organization repair, hyalinized giant cells, etc., which in turn gives way to (*c*) a more radial portion

of tumor and endothelial overgrowth, while the most distal portion from the center consists of (*d*) a transitional zone, showing early changes which gradually merge into normal brain tissue. Great variations in the type of vascular changes were found. The most striking of these changes are those in which an overgrowth of the lining endothelium alone occurs. This may be so extensive that the lumen of the vessel is filled but not entirely occluded, and small spaces are found in which blood apparently continues to circulate. Study of the early endothelial changes showed hypertrophy, with the cytoplasm increasing to a relatively greater degree than the nucleoplasm. Multiplication occurs by both mitotic and amitotic division. The authors found large amounts of reticulin-collagen associated with this endothelial hypertrophy. The possible sources of reticulin-collagen formation are considered, and the authors express the opinion that the endothelial cells produce the reticulin-collagen in this type of blood vessel hyperplasia. The second most frequent type of blood vessel reaction consists of overgrowth limited to the adventitial element. In this reaction the vessel endothelium remains a single layer in thickness and, aside from a slight swelling of some cells, shows no change. Other vascular changes include a combination of both the endothelial and adventitial types of overgrowth and a simple fibrosis of the media. A detailed description of the vascular changes is accompanied by a series of excellent plates illustrating the points emphasized.

The authors discuss the significance of the vascular changes and state that it is apparent that none of them is limited to this type of tumor, as the endothelial type of reaction is frequently observed in medulloblastomas and, occasionally, in all other varieties of gliomas, meningiomas and other mesodermal growths. This reaction has also been noted in new growths of other parts of the body. Adventitial growth is a characteristic of astroblastoma, as is also medial fibrosis. In considering nutrition and necrosis, the authors investigate particularly the relationship of vascular supply to necrotic areas. They believe that the conception of progressive obliteration of the blood vessels with deficient nutrition does not explain fully the necrosis, and reach the conclusion that much of the necrosis of these tumors begins as multiple sharply localized foci of dead tissues. This suggests to them the action of a diffuse noxious agent. Phagocytosis was investigated to determine if phagocytes were derived from microglia. For this purpose large blocks of tissue were prepared which showed that microglial activity was most abundant toward the periphery of the tumor. The more central sections of the tumor tissue showed a small microglial content, although the number of compound granular corpuscles was great. The authors believe that a great portion of the mobile phagocytes originate from the adventitia of blood vessels throughout the tumor. The vessels producing such phagocytes were generally small and were located toward the center of the tumor, where the greater portion of the necrotic tissue was found, and the authors conclude that these vessels are fully as important a source of compound granular corpuscles as are microglia. The formation of stroma and connective tissue is briefly considered. It is thought that the organization of frankly necrotic tissue is a special work of the fibroblastic elements derived from blood vessels. It is emphasized that although a necrotic area may become organized into a mass of fibrous tissue, this is a purely secondary and reparative reaction.

KUBITSCHEK, St. Louis.

SYPHILITIC TUBERO-INFUNDIBULAR SYNDROME: A CRITICAL REVIEW. JEAN LHERMITTE, Encéphale **27**:628 (July-Aug.) 1932.

A systematic review of cases and of literature shows that the localization of syphilis in the region of the third ventricle (hypothalamic and tubero-infundibular zones) provokes a series of particular manifestations of which hypersomnia, polyuria —insipida or glycosuria—sexual impotence and adiposity are the most frequent. Lhermitte concurs in this syndrome for the following reasons: (1) the grouping of morbid phenomena; (2) the absence of morphologic modifications of the cranium (sella turcica); (3) the exact correspondence of the morbid manifestations in human pathology and in animal experimentation; (4) the specific present-day ideas

of pathologic anatomy; (5) the fact that lesions limited to the pituitary do not produce this syndrome; (6) the fact that when pituitary alterations are accompanied by these symptoms and signs, it is a question of compression of the infundibular region by a tumor or other process.

A case by Schulmann is described. In this instance—a case of tabes with aortitis and gumma of the liver—there was complete absence of all the signs just mentioned. At autopsy the pituitary was found to be very much diminished in size, with almost complete destruction of the parenchyma. No one would have thought of diagnosing a pituitary disturbance. An observation by Broussilowsky is no less striking. A syphilitic patient, aged 56, at autopsy showed an enlarged pituitary and sella. Histologic study demonstrated a gummatous invasion. Yet this had not been a "pituitary case." Such facts allow a conclusion, with Camus and Roussy, and Claude and Lhermitte, that the anterior lobe of the hypophysis does not play a rôle in the metabolism of fat or carbohydrates.

Virchow observed the association of syphilis of the hypophysis with meningitis at the base, involving the optic and oculomotor nerves and producing softening of the thalamic area. In 1891, Barbacci mentioned this association of hypophyseal gumma and basal meningitis; it had been commented on also by Beadlen in 1877. In 1898, Hunter presented a case of thickened fibrous infundibulum, closely adherent to the sella, and with the infiltration extending to the meninges and periosteum. Other pathologic cases with similar findings were presented by Stroebe (1905), Turner (1905), Schaffer and Josephy (1920). All these studies show that when syphilis produces a gumma in the hypophysis, there is a tendency to extension into the infundibulum and meninges, and that many original assignments of function to the hypophysis may be due to these extensions. Thus, the Fröhlich syndrome (dystrophia adiposogenitalis) is apparently the expression of a diencephalic nerve lesion. Cohn has recently reported a case of hypophyseal gumma in a woman, aged 38, with a bilateral Babinski sign, absent abdominal reflexes, nystagmus, etc. —a group of findings clearly arising outside the hypophysis. Here, too, an extension of the process into the tuber cinereum and mammillary bodies was found at autopsy. Further citations of cases are reviewed from Skoubiszewski and from Payenneville and Caillau.

All these studies seem to converge on the fact that little evidence actually exists of a connection between the syphilitic syndromes of the tubero-infundibular region and specific lesions of the pituitary gland. Gummas strictly localized to the hypophysis are not accompanied by narcolepsy, amenorrhea, obesity or impotence; on the other hand, when these manifestations appear the findings allow one to assert an extension of the specific process to the brain. Lhermitte argues vigorously against the time-honored acceptance of the pituitary, per se, as a cause of these syndromes. He states that the error really harks back to the confusion of a causal lesion with localization of a function. This is the error argued against by Hughlings Jackson, Henry Head, and others, which has been responsible for so many theories on aphasia and kindred topics. The anatomicoclinical problem is one thing; the physiopathologic problem is quite another, and one must beware of seemingly logical connections which may be but ill advised mental jumps.

ANDERSON, Los Angeles.

THE PATHOGENESIS, ETIOLOGY AND MEDICOLEGAL SIGNIFICANCE OF "GENUINE" and POSTTRAUMATIC REAL NARCOLEPSY. C. ROSENTHAL, Arch. f. Psychiat. **96**:572 (April) 1932.

The cardinal symptoms of narcolepsy are: attacks of compulsive sleep of short duration occurring under favorable or unfavorable conditions, and states of marked bodily weakness under emotional excitement. Persons suffering from this disease also show the phenomena of delayed physical awakening, nocturnal restlessness, with somnambulism, and talking in sleep. Most of the patients complain of general exhaustion, easy fatigability, and certain signs of vegetative and endocrinologic disturbances, such as increased perspiration, irregularity of pulse, lymphocytosis, decreased basal metabolic rate, diminished libido and signs of pituitary disturbance.

Four cases are presented. Case 1 is that of a man, aged 23, in whom, following two years of military service, during which he was subjected to rather exhausting physical strains, a state of typical narcolepsy developed. Previous to military service there had been no symptoms other than congenital nystagmus. The question here concerned compensation claimed from the government. Case 2 was that of a man aged 35, who was struck by an iron bar in the upper cervical region. He was not unconscious, and there were no definite neurologic findings. During his stay in the hospital (three weeks) he complained of marked sleepiness; following discharge, he developed typical signs of narcolepsy. Here, too, there was a question of compensation. Case 3 was that of a girl, aged 21, who had always been of a rather peculiar make-up and even in childhood had shown a tendency toward sleepiness and states of exhaustion. At the age of 16 she contracted syphilis; after a course of treatment she was pronounced cured, and gave negative serologic tests with both blood and cerebrospinal fluid. Two years later, following an accident during which she struck her head against a stone step, a state of narcolepsy developed. Case 4 is that of a man, aged 28, who had had an attack of influenza some years before. At the time of observation he showed narcolepsy and a moderate degree of parkinsonism. About a year before admission to the hospital he had been struck in the occipital region by a heavy stone. Some time following that the narcoleptic attacks developed. In cases 3 and 4 there were also claims for compensation.

The author discusses these cases and reviews the literature from the following points of view: the pathology and etiology of the disease, the occurrence of different types of narcolepsy and the medicolegal aspects of the disease. He is of the opinion that real narcolepsy should be diagnosed only on the basis of narcoleptic attacks that are associated with (1) the nocturnal phenomena already outlined, (2) the occurrence of cataplexy and (3) the short duration and sudden occurrence of the attacks. He divides narcolepsy into three groups: (1) that occurring in persons of a certain makeup, following emotional or physical strains which are known not to cause permanent symptoms in the average person; (2) that occurring in persons subjected to some accident, with or without signs of cranial injury; (3) rare cases in which the attacks develop as a sequel to severe cranial injuries or inflammatory disease of the brain (symptomatic narcolepsy).

Rosenthal expresses the opinion that in group 1 the disease is probably due to constitutional or early acquired factors which are not causally related to the states of exhaustion. In these cases, therefore, no compensation should be allotted. In cases belonging in group 2, when a relationship can be established between the accident and the onset of the disease, some compensation is justifiable, although there, too, the disease is probably due solely not to the accident, which acts as a precipitating cause. In group 3, if the disease is clearly established clinically, it must be considered as due entirely to the disease process or injury, and full compensation should be accorded.

MALAMUD, Iowa City.

THE PATHOGENESIS OF OCULOGYRIC CRISES IN POSTENCEPHALITIC PARKINSONISM: A REPORT OF TWO ANATOMICOCLINICAL CASES. G. MARINESCO and SAINT DRAGANESCO, Rev. d'oto-neuro-opht. **10**:396 (June) 1932.

This article is based on a histologic examination of the nervous system in two cases of postencephalitic parkinsonism accompanied by oculogyric crises. In one, there was infiltration of a few small vessels in the cerebral peduncle, the bulbar floor and the cervical marrow, representing a burned-out inflammatory process. In both cases there were degenerative lesions in the substantia nigra and the globus pallidus. In the latter there were small foci of demyelinization, with swollen microglia cells, the protoplasm of which contained "scharlachophile" products. The pallidal cells were few. Noncharacteristic lesions were found in the cortex of the frontal lobe. Aside from slight chronic alterations of the bulbar nuclei, the vestibular apparatus showed no degenerative change other than chronic cellular atrophy of the nuclei.

This picture does not explain the crises of conjugate deviation. In the first case, there was a process localized especially in the oculogyric centers and pathways; in the other, the vegetative and extrapyramidal systems appeared to be involved. The character of the crises can be explained better by a consideration of the close connections of the vestibular apparatus with other extrapyramidal and vegetative centers and with the cortex. These close connections explain why an oculogyric spasm is almost always accompanied by other extrapyramidal and vegetative phenomena. The striate body, especially the pallidum, plays a rôle in the forced movements of the crises of conjugate deviation of the head and eyes. The opinion that these crises have their source in a lesion of the cortex or of the vestibular pathways and centers in the bulb is not accepted. In the two cases cited the maximal lesion was symmetrical and was predominantly located in the pallidum and substantia nigra and not in the cortex.

Anatomicopathologic researches appear insufficient to explain the mechanism of crises of conjugate deviation. It may be interpreted rather as a dynamic phenomenon. There is first a state of decerebration in consequence of a paroxystic inhibition of the cortex, following which the phenomena of liberation, and perhaps also of excitation, supervene in the extrapyramidal system, especially in the superior vestibular centers and pathways. During the crises the disturbances of the vestibular apparatus are of a paroxystic dynamic nature; there is absence of the nystagmus response, owing to the oculogyric spasm, while tonic deviations of the trunk and arms are normal. After the crises the vestibular system exhibits only slight perturbations.

The crises appear also to be connected with changes of the acid-base equilibrium. In parkinsonism there is acidosis in the blood with modifications of chronaxia, which is in close relation with the humoral medium. A comparison may be made between oculogyric crises and epileptic attacks, in which physicochemical variations of the humors play an important part. Crises of conjugate deviation can be influenced by suggestion, through cortical inhibition, though not solely by it; there must be present also a particular superexcitability of the superior vestibular centers. It has been demonstrated that transauricular galvanism can cause the attack to cease, and Marsalet has shown that, in parkinsonism, prolonged cold irrigation of the ear causes temporary disappearance of the postural reflexes and the hypertonia. Probably these factors provoke a particular chronaximetric regimen at the level of the vestibular centers and pathways.

A certain rôle is played, also, by disturbances of the vasomotor system, especially by the vestibulovegetative reflexes. In postencephalitic parkinsonism, vestibular excitation by cold irrigation of the ear cannot provoke vasomotor modifications but these do occur after atropinization of the patient.

DENNIS, Colorado Springs.

TWO POSSIBLE FORMS OF SPEECH DISTURBANCE IN LESIONS OF THE BRAIN. K. GOLDSTEIN, Arch. f. Psychiat. **95**:730 (Nov.) 1931.

In this paper, which was read at the meeting of the Southwestern Neuropsychiatric Association of Germany in May, 1931, Goldstein presents a review of his theories on aphasia. In an approach to the studies of these disturbances one must take into consideration: first, an analysis of the meaning of the disturbance to the whole organism and its relationship to a given situation; second, a consideration of what Goldstein calls the "total energy capacity" of the diseased organism. An appreciation of the influences of the first factor can be obtained only from studies of the same patient in different situations and of different patients reacting to similar situations. The symptoms may be predominantly the expressions of adaptation of the person to certain situations rather than an expression of the lesion itself. The consideration of the total energy capacity is important, because there, too, the symptoms on the surface may be the effects of adjustment rather than the effects of the lesion itself.

A person whose expression to the outside world is hampered by a lesion of the brain but whose energy capacity remains the same, or is even decreased, will

have to economize in order to accomplish this expression, and in this economy he may have to use certain by-ways which would then be the actual determinants of a given symptom. For instance, it is easier to express simple contents than more complicated ones. The aphasic person will grasp this fact in helping his expression, so that this will not be a primary result of the lesion but a secondary one due to attempts at adjustment. Here, too, one must remember that new and isolated contents are more difficult to express or to grasp than those that fit into a broader picture. It is because of this that the aphasic person will find it easier to grasp or express a whole sentence than, for instance, one word or one syllable. These factors make it important to try to differentiate between the secondary symptoms of aphasia and those that may be primary.

In this report the author is concerned with two possible forms of speech disturbances: (1) those in which the so-called structures of speech are disturbed, and (2) those in which the disturbance is in the expression of these to the outside world. The latter are the ones that the author is particularly concerned with, and include so-called motor aphasia. In studying these the effects of economization in view of a certain given total energy capacity are particularly striking. The patient may resort to certain measures to make his expression easier. Such things as the utilization of emotional in preference to nonemotional contents, expressions rendered easier by virtue of the fact that they are related to some patterns laid down earlier in his life, the attempt at evading the necessity of rapid change in the contents of expression, and consequently a tendency to stick to trends already started, and numerous other by-ways can be noted in patients of this type. This, however, does not mean that these are the effects of the lesion, but again must be considered as secondary elaborations for the purpose of easier adjustment.

The author discusses further the so-called inner speech and its relationship to certain types of aphasias which he terms central aphasias. He then proceeds to discuss two forms of paraphasia, which he calls the literal and the verbal, in the light of the general principles outlined in the introduction. He sums up his discussion by stressing the fact that only through a full appreciation of the particular personality construction, as well as the situations given, can one come to a proper appreciation of what is primary and what is secondary in the results of aphasic speech.

MALAMUD, Iowa City.

ENCEPHALOGRAPHY UNDER NARCOSIS PRODUCED BY NONVOLATILE ANESTHETICS. H. C. SOLOMON and S. H. EPSTEIN, J. A. M. A. **98**:1794 (May 21) 1932.

The use of nonvolatile anesthetics in the performance of encephalography or pneumorachicentesis is discussed. The authors' experience was obtained chiefly with pentobarbital-sodium. They believe, however, that what can be said about the use of this drug is equally true of sodium isoamylethyl barbiturate, as they have used the latter preparation for anesthesia for other purposes, and the clinical and physiologic results are very similar. Their procedure is to give an intravenous injection of from 0.3 to 0.5 Gm. (from 5 to 7½ grains) of pentobarbital-sodium dissolved in from 10 to 15 cc. of distilled water. The solution is injected slowly, from three to five minutes being taken for the injection. The patient is usually in a state of narcosis by the time the injection is completed. Occasionally a subcutaneous injection of 0.16 Gm. of morphine sulphate is given fifteen minutes before the pentobarbital-sodium. The narcosis obtained is profound. The deep reflexes are abolished, as are the skin and gag reflexes. This state of areflexia and complete anesthesia is obtained in from ten to twenty minutes after the injection, and the patient is then ready for the encephalographic procedure. As the patient is in a state of muscular relaxation, it is convenient to have an apparatus that will hold him in position for the injection of air. The authors use an apparatus consisting of a jointed stretcher which may be placed on the operating table; the anesthetic is administered while the patient is lying supine on the stretcher. About midway along each side of the frame there is a joint with a semicircular disk containing a number of holes into which pins may be placed.

In this way various angles of the sitting position may be obtained. The patient is held in place by a head sling, two shoulder straps hung from the top of the frame and an abdominal strap fastened to the sides. The lumbar puncture and the injection of air are made, with the patient in an upright position, through a rectangular opening in the canvas which forms the back of the apparatus. The injection of air usually takes from fifteen to thirty minutes. During this period the patient is completely anesthetic, the operator is not disturbed by complaints from the patient, the injection is not interrupted, nausea and vomiting do not occur, and there is practically no diaphoresis. The roentgenograms are made with the patient in a state of anesthesia which enables one to put the head in any desired position; no vomiting occurs, as is frequently the case when an injection of air is performed without anesthesia, and thus the roentgenologist has no interference with his technic from the patient. In dealing with psychotic, disturbed or fearful patients, this is of especial advantage. The narcosis gradually wears off in the course of from four to six hours. On awakening, the patient rarely has a complaint and usually is able to take nourishment. There are, as a rule, no headache, no gastro-intestinal symptoms and no fever. Headache frequently does occur some hours later, but at this time it is rarely very severe and is easily controlled by a moderate dose of some opiate. The authors have encountered no special contraindications to the use of pentobarbital-sodium anesthesia in cases selected for encephalography. They have employed this drug in twenty instances, mainly in cases with symptoms of intracranial pathologic conditions other than those of tumor.

EDITOR'S ABSTRACT.

MECHANISM OF ACCOMMODATION STUDIED EXPERIMENTALLY. MAX F. MEYER, Arch. Ophth. **8**:53 (July) 1932.

The problem of the mechanism of accommodation is undetermined. Nobody doubts that the lens of the human eye changes its shape in the process of accommodation. Nevertheless, the lens lacks any known physiologic properties through the mediation of which it could, in response to stimulation, change its shape spontaneously. There are three influences which could account for this: (1) radial pull applied to its circumference; (2) a contracting push applied to its circumference and acting toward its axis or (3) hydraulic pressure applied to one of its two surfaces, provided that the yielding of its peripheral parts is more obstructed than the yielding of its more central parts. (Hydraulics, of course, includes hydrostatics.) The first two of these, especially the first, has been discussed in ophthalmic literature for nearly a century, with numerous arguments for and against. The third has been almost wholly neglected. In this report, the author considered entirely this third possibility, i. e., judging the shape of the lens by hydraulic forces.

Meyer constructed a flexible lens of gelatin (after thirteen unsuccessful attempts), fused it with formaldehyde, mounted it on a metal ring, and placed it between two chambers, the entire case being of bakelite. One chamber communicated with a metal bellows such as is used for operating a steam valve; the other could be uncovered, and communicated with the outside air. The metal ring acted as a suspensory ciliary body. The mechanics of the experiments and the individual conclusions therefrom are of great interest.

A possible theory, taking into consideration the deformation of the lens as it occurs in accommodation, may be advanced. A complete mathematico-optical theory of deformation of the lens is not to be expected of any one. For that, experimental data are needed which are not now possessed, because hitherto nobody has experimented with solid and flexible lenses, either mechanically or optically.

One must consider what would happen to the curvatures of the two lens surfaces under the assumption that all the molecular displacements would occur strictly parallel to the axis of the lens. This assumption can also be worded by saying that the lens, for mathematical purposes, might be thought of as a collection of infinitely thin prisms, all lying parallel to the axis of the lens, each of the prisms being capable only of sliding along its own axis and not of any other motion or of

any shortening or lengthening. From his mathematical figures and by the application of the calculus, Meyer demonstrated definitely that the lens is and ought to be asymmetric, and that whenever hydraulic pressure interferes with its state of rest, whenever it pushes the rear surface and reduces its curvature, the front surface gains vastly more in curvature than the rear surface loses.

The author's final conclusion may be quoted verbatim: "That this disproportionate change in curvature is an explanatory feature of prime importance will appear plausible to the reader. Nevertheless, it is not asserted that this is an exhaustive mathematical treatment of the optical problem of flexible lenses. Still it makes one feel less bewildered at the outcome of the experiment, in which I discovered the fact, expressly denied by Helmholtz, although he guessed at it, that the mere concentric flexing of a lens reduces its effective focal length."

SPAETH, Philadelphia.

CONVALESCENT SERUM IN THE TREATMENT OF POLIOMYELITIS. EDITORIAL, J. A. M. A. **99**:1266 (Oct. 8) 1932.

The status of the treatment in preparalytic cases of acute poliomyelitis seems to require clarification. Although prevailing clinical opinions as to the efficiency of the treatment have been optimistic, few investigations have been adequately controlled. In two recent reports of controlled therapeutic tests, the evidence provided is not encouraging. Kramer, Aycock, Solomon and Thenebe (Convalescent Serum Therapy in Preparalytic Poliomyelitis, *New England J. Med.* **206**:432 [March 3] 1932) record 82 cases about equally divided between the patients who received convalescent serum and those who did not. They did not accept for the study any case of illness which had lasted more than three days on admission to the hospital or any case which at that time showed any paralysis or muscular weakness. In all these cases the physical and spinal fluid conditions characteristic of preparalytic poliomyelitis were present. Convalescent serum was given to about half of this group immediately on admission to the hospital, and additional doses were given from eight to twelve hours apart. Careful examinations of muscles were made on admission, again after from twenty-four to forty-eight hours, and again before discharge from the hospital. Paralysis developed in 51 per cent of the 82 patients studied, and 2 deaths from respiratory paralysis occurred in the treated group. The Boston investigators concluded that their study offered no statistical evidence that convalescent serum is effective. The second report is that of Park (Therapeutic Use of Antipoliomyelitis Serum in Preparalytic Cases of Poliomyelitis, *J. A. M. A.* **99**:1050 [Sept. 24] 1932), published in the symposium on poliomyelitis in *The Journal of the American Medical Association.* Together with members of the poliomyelitis committee of the New York Academy of Medicine and his associates in the municipal hospitals, Park studied a total of 927 preparalytic cases of poliomyelitis; 519 of the patients were treated with convalescent serum; 408 were not given serum. The health department supplied the serum. The amount of paralysis present, if any, was noted at the end of three weeks and again after from five to six months. While the cases of the treated group of patients cared for by the pediatricians were on the average classified as a trifle more severe, this difference was not apparent in the large number of untreated hospital patients used for comparison. Paralysis developed in 19.6 per cent of the patients treated with convalescent serum and in 11 per cent of the untreated patients. The mortality rate among the treated patients was 3.8 per cent and among the untreated patients, 0.9 per cent. The results of this study by a group of pediatricians and public health experts likewise does not afford statistical proof that the use of serum has any value in cases in which the cells of the central nervous system are already involved. The fact that the two controlled therapeutic tests gave similar results suggests that heretofore too much confidence has been placed in the treatment with convalescent serum. Nevertheless, the optimistic opinions expressed by others following uncontrolled observations cannot be disregarded. The need now is for additional evidence based on controlled studies which take into account the variants that make the problem complex. In

the meantime, it is of great importance to the public, as well as to the patients, that cases of poliomyelitis be diagnosed in the preparalytic stage, so that the patients may be isolated.

THE SYNDROME OF FINGER AGNOSIA, RIGHT AND LEFT DISTURBANCE, AGRAPHIA AND ACALCULIA. JOSEF GERSTMANN, Jahrb. f. Psychiat. u. Neurol. **48**:135, 1932.

Agnosia of the fingers was described for the first time by the author in 1924 as an inability to recognize, designate, select and differentiate the individual fingers on looking at both hands. Soon thereafter this symptom was found to be regularly associated with a disturbance in right and left orientation, agraphia and acalculia of varying degree as a characteristic syndrome indicative of cerebral pathology. Since then the syndrome has been found and described by various observers, either as an independent clinical picture or as a residual manifestation of more or less complicated cerebral lesions. Gerstmann's original case of agnosia of the fingers occurred in a patient with a focal softening in the lower portion of the left temporal lobe, in the region of the angular gyrus. Other observers found this syndrome also in cases of tumor in the same region and in the occipital lobe immediately adjacent to it.

The inability to recognize the fingers may be partial or total and may refer to the patient's as well as to the examiner's fingers. Agnosia of the fingers may occur in spite of the patient's fairly good preservation of intellect and in spite of his theoretical knowledge as to which finger is to be recognized. It is due to a failure of orientation and may be present in spite of well preserved vision. It is noteworthy that in all the cases reported in the literature, contrary to what one would expect, aphasic, agnostic and dyspraxic phenomena were not present, at least not at the time when the syndrome was most prominent. It is also noteworthy that in agnosia of the fingers the ability to recognize, use, name and differentiate other segments of the body or of the limbs is undisturbed.

The other components of the syndrome are: disturbance in orientation as to right and left handedness, agraphia and acalculia. Their frequent association with agnosia of the fingers can readily be understood when one bears in mind the close relationship between the early acquisition of writing and calculating and the physiologic differentiation of the hand, as well as of the individual fingers and right and left directions. These early acquisitions become closely connected with each other and are finally deeply rooted into the entire functional capacity of the person. They remain as deeply anchored primitive functional complexes even after the original components of these functions have attained apparently complete autonomy in the course of their further development.

In some cases the syndrome may be associated with right hemianopia, amnesia, anomia, alexia, disturbances in the recognition of colors, alexia, dyspraxia, absence of optomotor nystagmus and disturbances in equilibrium. These coexisting symptoms, however, are not essential features of the syndrome; they are to be regarded as "neighboring symptoms."

KESCHNER, New York.

A CASE OF OCULOGYRIC FITS IN ENCEPHALITIS ACCOMPANIED BY OBSESSIONS AND DISTURBANCE OF IDEATION. ORNULV ODEGARD, Acta psychiat. et neurol. **7**:855, 1932.

The author reports the case of a woman, aged 27, who had encephalitis in 1924, with predominance of mental symptoms (elation, confusion and some disturbance of sleep). Following this there developed an asthenic and hypochondriac condition with gradual change of character (she grew suspicious, fearful and ill-tempered). From 1927, she had typical oculogyric fits, during which the following obsession would repeat itself in a stereotyped way: She seemed to see herself walking through the town to a certain place at the canal and then throwing herself in the water with the idea of committing suicide. The obsession was accompanied by

considerable anxiety, and it faded away somewhat earlier than the ocular spasms. Following these attacks she felt better with regard to mood, mobility and strength for about two days. During the ocular fits (later on, even to a minor degree between the fits) she would experience marked difficulty in imagining things, i. e., in making a mental picture of how even familiar persons or objects looked. More rarely she had shorter attacks of conjugate deviation to the left, when she would see changing, reddish patterns in front of the eyes, but had no obsessions. From the time when the ocular symptoms started, there gradually developed a marked general rigor, with bradyphrenia and a masklike facial expression.

The symptoms showed an interesting connection with the conditions of the patient's life and her mental state. Because of an unhappy married life she had been depressed and unhappy since before the development of encephalitis, and frequently had had suicidal ideas. During the illness the situation became even worse. Following divorce, in 1929, she became less worried and unhappy, and some time after this the obsession of suicide during the attacks disappeared. At the same time she stated that the attacks had became much less severe, and that the ability to imagine things also had returned to some extent. She was at least able to make a mental picture of the two persons she loved most: her father and her baby.

From this case the author concludes that the tendency to tonic spasms of the eyes is a direct result of the encephalitic brain lesion. The spasms (or rather the condition of the brain which causes the spasms) evidently furnish a predisposition to obsessive mechanisms, as the patient never presented any obsessive-compulsive tendency outside the attacks. But the obsessions became evident only as long as she was fearful and depressed on account of her marital unhappiness. When life conditions grew more bearable the obsessions disappeared, whereas the ocular spasms remained unchanged. The author believes that, because during the ocular spasms the disturbance of ideation was generally more marked than otherwise and at the same time a certain complex of highly emotional ideas was reproduced with a definitely exaggerated intensity, there was an increased tension within the patient owing to blocking of efferent pathways, perhaps in subcortical centers, and this tension was relieved by the motor and emotional outbrust represented by the spasms and the obsessions. This is the same mechanism that is present in the neuroses, but in these the barrier is of a functional nature, while in encephalitis it is organic.

PEARSON, Philadelphia.

NEURALGIA AND ANESTHESIA OF THE TRIGEMINUS, PARALYSIS OF THE SIXTH NERVE AND THE SYNDROME OF CLAUDE BERNARD-HORNER, FROM A SYPHILITIC LESION OF THE APEX OF THE PETROUS BONE. H. ROGER Y. POURSINES and J. ALLIEZ. Rev. d'oto-neuro-opht. **10**:490 (July-Aug.) 1932.

Simultaneous lesions of the fifth and sixth cranial nerves and the ocular sympathetic nerve are rare. A married woman entered the clinic in May, 1932, complaining of pain in the face and ocular difficulties. The pain had begun two months previously, and one month later horizontal diplopia had appeared. There was paresthesia of the left side of the face, accompanied by hyperesthesia; the least touch, the movement of the eyes, speaking or mastication caused pain. Examination revealed mucous and cutaneous hypesthesia in the domain of the fifth nerve. The motor division was not affected. The patient had noticed less sweating on the left side of the face and fewer tears from the left eye. There was complete paralysis of the left abducens. The syndrome of Claude Bernard-Horner was represented by narrowing of the palpebral slit, enophthalmia and miosis. There was diminished hearing in the left ear due to a middle ear disturbance. The vestibular apparatus of each side was slightly hypo-excitable. The arterial tension was systolic 220 and diastolic 110.

Two hypotheses may explain the association of the syndrome of Claude Bernard-Horner with that of Gradenigo. Although a central bulbopontile lesion could involve the nuclei of the origins of the fifth and sixth nerves and the sympathetic fibers, in the case reported there were no disturbances of the facial nerve or of the sensory and pyramidal tracts. Consequently it is necessary to

postulate the existence of a lesion of the ocular sympathetic fibers in the posterior part of the middle cranial fossa or, better, a lesion of the anastomoses of the carotid sympathetic plexus with the trigeminus. In a case reported by Roeder there was a lesion of the fifth, sixth and ocular sympathetic nerves and also of the second, third and fourth nerves. Autopsy revealed a tumor of the middle fossa that had destroyed the gasserian ganglion and the sympathetic fibers from the carotid plexus to the trigeminus, and had compressed the third, fourth and sixth nerves.

The etiology in the case reported was furnished by the history and by the laboratory examinations. The patient had had eight pregnancies; there had been one abortion, and six children had died at an early age. The Bordet-Wassermann reaction was positive in the blood and spinal fluid. The latter revealed a slight hyperalbuminosis (0.5 Gm.) with 21 cells to the cubic millimeter. Antisyphilitic therapy caused rapid improvement. The lesion was either a gummatous meningeal plaque at the base or syphilitic osteitis of the tip of the petrous bone. A roentgenogram revealed clouding and thinning of the posterior clinoid apophyses, slight widening of the left sphenoidal fissure and increased transparency of the left petrous tip. These findings favor the hypothesis of osteitis.

DENNIS, Colorado Springs.

ATYPICAL FACIAL NEURALGIA. DAVID C. WILSON, J. A. M. A. **99**:813 (Sept. 3) 1932.

According to Wilson, the sensory supply of the area involved in the atypical neuralgias is from the posterior roots of the cervical nerves, the vagus, the facial, the glossopharyngeal and the trigeminal nerves. There is much evidence, anatomic and experimental, to indicate that there are no afferent fibers supplying the face present in the cervical sympathetic system, but that the sympathetic is in some way involved in the condition under discussion. It also seems that removal of the trigeminal supply does relieve a few patients, while section of fibers from the vagus and glossopharyngeal nerves relieves others; sympathectomy alone does not relieve. The symptom complex of atypical neuralgia, however, is similar and seems to involve the same mechanism as both the migraine-like attacks that accompany or follow hemicrania and the troublesome discomfort occurring in the anesthetic area following trigeminal section, but the neuralgias of the individual cranial nerves, the vagus, the facial, the glossopharyngeal and trigeminal nerves, are separate entities and should not be confused with this condition. The author reports seven cases of discomfort of the face with the characteristic of atypical neuralgias. Three of these patients had had injections into the sphenopalatine ganglions; four had had teeth removed because of pulp-stones, and all had had much work performed on the nose and on the sinuses. From these cases one can conclude that, in addition to the picture described by the neurosurgeons, three other characteristics of atypical neuralgia exist. These are as follows: First, the emotional disturbance and the change in the behavior are out of proportion to the symptoms; second, the personality of these patients is often of a similar type — they are sensitive, egotistical and self-centered, in most cases sublimating for an underlying feeling of inferiority, thus making the defense of the egosuperiority so essential; third, their physical well-being seems almost impossible in the presence of such suffering, and suggests that the pain acts like a paranoid delusion, enabling the individual to exteriorize a painful conflict, thus protecting the personality and benefiting body functions. From these cases, also, the conclusion is reached that some cases of atypical neuralgia are psychogenic in origin, some are based on deep conflicts and are part of a developing psychosis, and others are based on a more superficial conflict. The author agrees with Davis and Pollock that pain is probably caused by a sympathetic disturbance in the face that is translated into pain by the sensory nerves. In treating such conditions, psychotherapy should come first. Allergy should be tried, but, if surgery is to be attempted, unless the sensory symptoms suggest one particular cranial nerve, there is little likelihood that relief will be obtained unless all cranial nerves are

severed. Atypical neuralgias, finally, are thought to be due to a sympathetic disturbance in the face, which may arise from many irritants, but especially from intrapsychic conflicts in which there is danger of loss of self-esteem. The pain leaves when the conflict is solved, and relief can be obtained through psychotherapy.

EDITOR'S ABSTRACT.

LATE VESTIBULAR SEQUELAE OF EPIDEMIC ENCEPHALITIS. J. A. BARRÉ, Rev. d'oto-neuro-opht. **10**:385 (June) 1932.

The vestibular reactions in cases of epidemic encephalitis vary according to the stage of the disease at which the examination is made, initial, convalescence, the beginning of parkinsonism or the late stage. During the last ten years, improvements have been made in clinical and instrumental examinations of the vestibular apparatus; Barré has investigated the mode of action of scopolamine by making examinations before and after its administration, as well as during the period of its action. Twenty cases have been selected for this report, in all of which the observations were complete. The phenomena studied were spontaneous vertigo, Romberg's sign and the pulsions, nystagmus and the sign of the extended arms.

An analysis of the vestibular manifestations, both spontaneous and provoked, shows that the vestibular apparatus does not respond with a characteristic formula to the poison of encephalitis. In general, there are few subjective signs in the late stage of the disease; nystagmus is of small amplitude and pulsions are infrequent, all of which constitute one of the slight differences that exist between parkinsonism and the postencephalitic parkinsonian syndrome. In the test of the extended arms, a curious phenomenon occurs in some cases, namely, a progressive flexing of the elbows, wrists and fingers — the so-called "arms in quotation marks." This is not a vestibular sign, but belongs to the general disease and especially to the striospinal system. The deep-seated hypertonia of the disease is imposed on the vestibular reactions and sometimes annihilates them. In most cases the reactions to the instrumental tests reveal hyporeflectivity, which differs from that seen in other conditions in that it is characterized not so much by deficits as by a slowness of inception and a curbing and deforming of its manifestations. It is also probable that the discordance between the reflex reactions of the eyes, limbs and trunk is due to the unequal distribution of the hypertonia of parkinsonism. While the hypertonia masks the vestibular manifestations, the contractures may increase the disequilibrium in the presence of even a slight vestibular disturbance, by preventing prompt reactions. Taken all together, examinations of the vestibular apparatus in parkinsonism have not yielded precise or utilizable data. If the hypertonia of parkinsonism is envisaged as specially linked to lesions of the striospinal system, it is possible that one has been considering as pure what is really a complex element. The vestibular apparatus has been viewed across the contractures of the extrapyramidal system. For this reason, vestibular examinations were conducted on patients under the influence of scopolamine in order to suppress the extrapyramidal contractures and to permit a more direct study of the vestibular apparatus. The results will be reported later.

DENNIS, Colorado Springs.

ACUTE PERIVASCULAR MYELINOCLASIS ("ACUTE DISSEMINATED ENCEPHALOMYELITIS") IN SMALLPOX. J. PICKFORD MARSDEN and E. WESTON HURST, Brain **55**:181 (June) 1932.

The term acute perivascular myelinoclasis is used to indicate the essential feature of the disease, which is destruction of the myelin sheaths in a zone around the vessels. As early as 1724, symptoms of disturbance of the nervous system were recognized as complicating or following smallpox. From an intensive review of the literature, among the complications of variola were: (1) a disturbance of speech that was remarkably similar in all instances, and (2) paralysis of the limbs, with or without sphincteric disturbance. The clinical course in the cases of seven patients suffering from acute nervous symptoms in association with smallpox is described in detail. Three died and were examined pathologically; they exhibited changes typical of acute perivascular myelinoclasis. The average age

in this group was 12 years, with extremes of 7 and 21. The early phases of the disease were marked by a moderate or pronounced pleocytosis, which rapidly fell in a few days; the Nonne-Apelt reaction was invariably negative. Four other patients presenting borderline and intermediate stages form a second group. It is as yet difficult to judge of the value of convalescent serum; further corroborative work is necessary.

The similarity of the incubation period of the nervous condition both after vaccination and in smallpox is striking; drowsiness is the outstanding feature. In the encephalitic type of disturbance the drowsy state may deepen to stupor and then to coma, with abolition of the reflexes. A liability to transient, intermittent loss of sphincter control follows the course of the disease. Depending on the severity of the initial paralysis, recovery is almost complete. Sensory disturbances commonly occur with the motor difficulties. Although mental changes may be superimposed in the early phases, in none of the patients who have recovered has there been permanent mental recovery. In view of the same clinical and pathologic conditions following different predisposing causes, such as smallpox, measles and antirabic treatment, it would appear that an independent malady is present. The periodicity of the occurrence of acute perivascular myelinoclasis argues against the theory of direct causation. Evidence for the consideration of the disease as an independent condition is reviewed and supported by the authors. In the neurotropic virus diseases of man and animals the brains exhibit the polioclastic type of inflammation (Schroeder), but in the myeloclastic diseases not one has been shown to result from the action of a virus. It is concluded that although the etiology is unknown, it may be connected with that of acute focal myelinoclasis and of disseminated sclerosis.

MICHAELS, Boston.

ASTHENOPIA, A PSYCHONEUROSIS AND A MEDICAL RESPONSIBILITY. C. W. RUTHERFORD, J. A. M. A. **99**:284 (July 23) 1932.

According to Rutherford, asthenopia is a syndrome in which the visual discomforts that attend prolonged close work are accompanied by feelings of fatigue and reflex manifestations remote from the eye. It can be classed as a psychoneurosis because of its mechanism and symptomatology. The term eyestrain may be reserved for those cases in which visual discomforts are brought on by prolonged close work, are limited to the eyes, and promptly disappear when close work is discontinued. An emmetropic person with good accommodative power has the advantage of sharp retinal images to assist in stabilizing binocular fixation at close work. An ametropic person lacks this advantage, and is only partially compensated when made emmetropic by correctly fitted lenses; he usually has another disadvantage in his accommodative sensitivity or power. In hyperopia this power is generally too great, and continuous use of the eyes is apt to cause accommodative spasm with excessive convergence and blurring of images. It is an artificial myopia; both far point and near point advance toward the eye. The spastic condition brings on fatigue prematurely. In myopia the power is generally too weak, the accommodation soon fails, the near point gradually recedes from the eye, and there is no ocular compensating mechanism; because of early fatigue the convergence relaxes and there is a blurring of images, or even diplopia. To continue at close work under either circumstance requires the expenditure of greater and greater amounts of energy. There is a rapid accumulation of fatigue with its train of unpleasant and annoying experiences. Either emmetropic or ametropic persons may have some sensitiveness, weakness or instability of the nervous system, by reason of which they are subject to feelings of fatigue consequent to continuous or prolonged use of the eyes for close work. When fatigue develops there is an insistent desire to rest. If work is continued in spite of fatigue, the attention lags and must be forced. The experience becomes so unpleasant that the unconscious mind rebels and develops a system of emotional reaction for the protection of the individual. It is the instinct of self-preservation, the protective reaction of the nervous system. No asthenopic patient should be told "There is nothing the matter with you; forget it!" There *is* something the matter with him;

he *can* not forget it; he *will* not forget who told him! Thorough questioning will reveal the direct and contributing causes of symptoms. A carefully planned and executed examination will disclose the nature and extent of ocular and visual defects; it will likewise impress the patient that he is being taken seriously and that his case will be understood.

EDITOR'S ABSTRACT.

THE ANATOMY OF THE GASSERIAN GANGLION; ITS RELATION TO TIC DOULOUREUX. F. VAN NOUHUYS, Arch. Surg. **24**:451 (March) 1932.

Van Nouhuys has studied the structure of thirty-eight ganglia removed from cadavers. In no case did he find three anatomically separated parts in the sensory root corresponding to the three terminal divisions of the fifth cranial nerve. He states: "In hardly any of the sensory roots examined did the bundles run parallel, with very little interchange of fibers. On the contrary, there were as a rule many anastomosing and interlacing fibers." Again, he says: "As a rule, the ramifications and anastomoses were most numerous at the hilus of the ganglion, where in some cases there was such a network of fibers that one would be justified in speaking of it as a plexus." Most of the ramifications and anastomoses were found in the medial half of the sensory root, the pathways of the ophthalmic and maxillary divisions interlacing considerably. In most cases, some fiber bundles joined the motor root from the maxillary-mandibular portion of the ganglion.

From a study of serial sections of the ganglia the author found no indication that the cell groups represented separate units or that the interstitial tissue separated definite nerve bundles. He is unable to agree with the conclusions of Frazier, which he recalls are based on the ganglion of the fetus and not on the fully developed ganglion of the adult. Furthermore, he believes that the fibers in the sensory root of the adult have no definite parallel arrangement. He adds that the structure of the sensory nerve varies between two extremes. On the one hand, the bundles may have a parallel course, maintaining the same relation with other bundles throughout the length of the root, which Nouhuys has not found, while, on the other hand, there may be a plexus of fibers only, without regular arrangement and without any bundles running parallel. Between these two extremes, many variations may be found, for example, sensory roots with interlacing bundles of fibers and with bundles running practically parallel but anastomosing frequently and in large number. The author observes that Dandy came to similar conclusions as a result of clinical observations.

Nouhuys concludes as follows: "1. The sensory root of the fifth nerve is not composed of three parts that correspond to the three peripheral branches from the gasserian ganglion. 2. The operation of partial section of the sensory root, assuming that the pain is carried by bundles having a definite location, is not based on anatomic facts, and therefore cannot be regarded as an absolutely reliable procedure."

ELVIDGE, Montreal, Canada.

EDUCATION OF THE PUBLIC IN MENTAL HYGIENE. STANLEY P. DAVIES, Ment. Hyg. **16**:238 (April) 1932.

Psychology has become not only popularized, but vulgarized; it enters advertisements and books, magazines and newspapers, drawing rooms and subway cars. More than the Oedipus complex, more than the inferiority complex, people are suffering from the complex complex. This is said seriously and not in derision, for it is not strange, perverse or abnormal that people should be interested in themselves. Associated with this popularization of psychology is a growing demand for psychiatric service, a demand which present facilities cannot fulfil. Since the public is determined to have this service, it will turn to charlatans and quacks if legitimate practitioners are inadequate. To this problem there are two solutions; one is to make the public less conscious of their unconscious, to abandon the campaign which has popularized psychology, with the hope that the demand will then diminish until it is within the present range; a second solution is to increase the psychiatric personnel and mental hygiene facilities. The latter alone can be considered. It would be impossible as well as undesirable to desensitize

the public on this subject; it would be tantamount to telling the neurotic person in the small town to shift for himself until he qualified for a state hospital, and then he would receive psychiatric care.

To broaden the supply of psychiatric service rather than to curtail the taste for it requires a strong public opinion that will lead to the appropriation of liberal sums for community mental hygiene work. When this occurs, attractive positions in the psychiatric field will be created, which a well trained personnel will eagerly fill.

One of the evils of inadequate knowledge of psychology and psychopathology is the tendency of persons to be overaware of their own mental processes; truly, in this field, to the layman, ignorance is bliss. Concentration should be not on the negative aspects of this problem, not on morbid psychology or psychopathology, but rather on the normal workings of the mind, on the methods of adjustment, on the technic of good habit formation and on the application of healthy psychology to daily life. This should be broadcast to the public through lectures and magazines, books and radio talks, public courses and newspaper columns.

DAVIDSON, Newark, N. J.

GROWTH RESPONSES IN CAUDALLY GRAFTED BRACHIAL SEGMENTS OF THE EMBRYONIC SPINAL CORD OF AMBLYSTOMA. BERNICE L. MACLEAN, J. Exper. Zool. **64**:71 (Nov. 5) 1932.

The seventh, the eighth and the ninth and sometimes a part of the tenth segments of the spinal cord of Amblystoma punctatum embryos were removed and replaced by the second, third and fourth; the third, fourth and fifth; the reversed third, fourth and fifth, and the fourth, fifth and sixth segments from other embryos of the same age. Normal anatomic and physiologic development followed in one third of the surviving animals. Cellular proliferation in the grafted second segment was so extensive and rapid that large outgrowths from it projected into the surrounding tissue. In the other cases, the size and number of cells in the grafted segments were greater or slightly less than, or equal to, those of cells in normal position at the age when they were examined, and were never reduced as low as the size and number of the cells in the new position. The reversed segments always developed more than their normal number of cells. The largest number of cells occurred particularly in the sensory areas, which have been shown to retain their embryonic character longer than the ventral portions. It is suggested that the second to the fifth segments of the embryonic spinal cord of Amblystoma possess high potentials for cellular proliferation, which diminish in degree caudad to the second segment, but which tend to be maintained and expressed when these segments replace regions of lower inherent capacity. Their degree of expression appears to be related to the position of the segments within the grafted unit and within the spinal cord as a whole.

Increased cellular proliferation, affecting sensory areas primarily, occurred in one or two segments adjacent to the graft. This was due possibly to the stimulative effect of the graft on these regions. The spinal ganglia which formed from the grafted segments were reduced to the size of the ganglia which they replaced, instead of retaining the size characteristic of them in their original position.

WYMAN, Boston.

SPONTANEOUS SUBARACHNOID HEMORRHAGE. W. R. OHLER and D. HURWITZ, J. A. M. A. **98**:1856 (May 28) 1932.

Attention is called to the fact that subarachnoid hemorrhage occurs much more frequently than is generally believed. Ohler and Hurwitz gathered twenty-four cases in eighteen months between July, 1929, and January, 1931. This number is about one-fifteenth the number of cases of cerebrovascular accidents and about equal to the number of cases of subacute bacterial endocarditis, a much better known condition. Subarachnoid hemorrhage is a striking syndrome with sudden onset, usually with headache, occasionally vomiting, dizziness, stupor or coma,

and rarely convulsions. Stiff neck, Kernig's sign, fever and slight leukocytosis serve to confuse it with meningitis. Hypertension is present frequently (twelve out of twenty-four cases). Systolic blood pressure over 190 was present in seven patients, of whom six died. The authors believe that hypertension and arteriosclerosis play an important rôle etiologically and prognostically. The average age of the group was 50, the youngest being 17 and the oldest 75. This is higher than in Neal's and Symond's series. Only one patient without an associated or a complicating disease died. Of the ten with an associated or a complicating disease, seven had hypertension (six over 190 systolic), one had diabetes with acidosis, one had bronchopneumonia and septic parotitis, and in one it occurred during the puerperium. Five postmortem examinations were done in the spontaneous subarachnoid group. These were all in patients brought into the hospital in deep coma. All but one showed cerebromeningeal hemorrhages. Of six patients entering in coma, all died. Coma adds to the gravity of the prognosis and obscures signs of gross cerebral damage. Seven cases of cerebromeningeal hemorrhage are briefly discussed. They may be differentiated clinically if they show evidence of brain injury (hemiplegia, Babinski reflex). The treatment in the cases of spontaneous subarachnoid hemorrhage and of cerebromeningeal hemorrhage consisted of daily lumbar puncture until the spinal fluid pressure remained normal, and sedatives, ice caps and the like for the headache. EDITOR'S ABSTRACT.

EXTENSOR TONUS AFTER SPINAL CORD LESIONS IN THE CAT. S. W. RANSON, J. C. MUIR and F. R. ZEISS, J. Comp. Neurol. **54**:13 (Feb.) 1932.

The authors are here interested in the influence of the corticospinal, rubrospinal and vestibulospinal tracts on the tonus of the limbs in cats. In adult cats under ether anesthesia, lesions were made on the right side of the rostral end of the spinal cord. The animals were allowed to survive the operation for from twelve to sixteen days, during which observations were made with the animals in various positions. After this period the cord was prepared by the pyridine silver technic and cut into serial sections. The caudal part of the third cervical segment was prepared by the Marchi method to determine the extent of the descending degeneration. On the basis of these preparations, the authors classified the lesions into five groups: (1) section of the dorsal part of the lateral funiculus at the level of transition between the medulla and spinal cord; (2) section of the dorsal part of the lateral funiculus at the level of the first cervical segment; (3) section involving chiefly the corticospinal tract; (4) section involving chiefly the rubrospinal tract; (5) lesions in the ventral funiculi and the ventral part of the lateral funiculus.

Section of the dorsal part of the lateral funiculus, including the corticospinal and rubrospinal tracts in the first cervical segment, caused hypertonus of the extensor muscles of the homolateral limbs, as evidenced by their extended posture and an increased resistance to passive flexion when the cat is supported in a hammock with legs hanging pendent, the flexing force being exerted upward against the pads of the toes. The authors believe that the evidence points to the corticospinal rather than the rubrospinal tract as the more important path by which tone-inhibiting impulses reach the cord. After lesions in the ventral funiculus, including the direct vestibulospinal tract, there was a definite weakness of the homolateral limbs, especially of the hind limb. Combined lesions of the ventral and lateral funiculi caused weakness of the homolateral limbs. The hypertonus caused by section of the dorsal part of the lateral funiculus disappears largely within two weeks. The weakness which results from lesions in the ventral funiculus decreases more slowly. ADDISON, Philadelphia.

OCCURRENCE OF INTRANUCLEAR INCLUSIONS IN HUMAN NERVE CELLS IN A VARIETY OF DISEASES. A. WOLF and S. T. ORTON, Bull. Neurol. Inst., New York **2**:194 (July) 1932.

The authors review recent work dealing with the occurrence of intranuclear inclusions. The results of experimental work reported by other workers strongly

suggested that intranuclear inclusions appeared to be characteristic of and specific for acute anterior poliomyelitis. The authors' study is based on two cases of acute anterior poliomyelitis: one in a boy, aged 5, who had died ten days, and the other in a girl, aged 4, who had died thirty-six hours, after the onset of paralysis. Intranuclear inclusions similar to those described by Covell and Hurst were found in the ganglion cells of the medulla and in the anterior horn cells of the cord in both cases. They were much more numerous in the second case and were rather rare in the first. The authors studied, as a control, material from the central nervous system in twenty-five cases; in twenty, the essential disease process was in the central nervous system, and in five the disease process was in other organs. Intranuclear inclusions similar to those in the poliomyelitic cases were found in all control material, either in the medulla or in the pons, and less frequently in the cortex, basal ganglia and spinal cord. Virus diseases and the interpretations of intranuclear inclusions are briefly discussed. The authors advance the following possibilities: 1. All the bodies, including those in poliomyelitis, may be the result of nonspecific nuclear degeneration or reaction. 2. A virus may be widely disseminated in the central nervous system but remain latent, giving rise to characteristic intranuclear changes only when severe organic disease occurs. 3. Specific intranuclear changes resulting from virus activity may be so closely simulated by degeneration products as to make differentiation difficult or impossible. It is thought that there is danger of confusing products of degeneration and the smaller bodies described as inclusions, and that a final decision of this question may need to await the development of new technical methods. At present the authors think that the intranuclear inclusions reported by Covell and Hurst are not specific for poliomyelitis.

KUBITSCHEK, St. Louis.

FAMILIAL PERIODIC PARALYSIS: A DESCRIPTION OF SIX CASES OCCURRING IN THREE GENERATIONS OF ONE FAMILY. T. KAY MACLACHLAN, Brain. **55**:47 (March) 1932.

The first case of family periodic paralysis was reported by Cavare in 1863; since then only about two hundred cases have been described. In all the authors' cases, there was a flaccid paralysis and an absence of the deep reflexes. Numerous etiologic causes have been suggested: spasm of the anterior spinal artery (Holtzapple), autointoxication, emotional excitement, fatigue and a chemical or physical change in the muscle plasma and toxic condition of the lymph (Buzzard). Although biopsies on muscle have been performed, the study has been valueless because there was no specific relation to attack. Reports on the excretion of creatinine have been inconsistent. Usually symptoms first begin about puberty and, as in migraine, the patient often feels exceptionally well on the day preceding an attack. The majority of the patients awaken in the early morning with a feeling of malaise, stiffness and weakness in the limbs, with a considerable variation in the march of the paralysis. In the most common form of the attack there is usually symmetrical involvement of the muscles of the lower limbs, and, more rarely, of the upper limbs. Sensation remains intact, with consciousness unimpaired. The author found no response to faradism or galvanism during the period of complete paralysis and an absence of tendon reflexes. In patients who have had the disease for many years, the muscles may be found to be fibrous or rubberlike in consistency.

The association of migraine and the paralytic attack is important, as previously reported by Holtzapple. Their relationship to gastric digestion is mentioned and an argument for a general toxemia is favorably considered but found to be insufficient in itself; the possibility of some abnormality in the muscle tissue is then posited. The author finds more similar features in a paralytic attack and epilepsy than in such an attack and narcolepsy and cataplexy. The author concludes that there is some inherent muscular deficiency on which a periodic disturbance of the vegetative system, with associated intoxication, acts to produce the paralytic attacks.

MICHAELS, Boston.

THE PLURISEGMENTAL INNERVATION OF NEUROMUSCULAR SPINDLES. FIDEL CUAJUNCO, J. Comp. Neurol. **54**:205 (Feb.) 1932.

Plurisegmental innervation of striated muscle fibers has been previously reported in the literature. The present study was made on the musculi flexor digitorum sublimis et profundus of the cat with special reference to the innervation of the neuromuscular spindles.

In a series of adult cats the inferior cervical ganglion, the anterior and posterior roots of the sixth cervical and second thoracic nerves and the anterior roots of the seventh cervical to the first thoracic nerves were extirpated on one side. From five to ten days later, one of the intervening posterior roots with its ganglion was extirpated, and from three to five days later, another was similarly treated, leaving only one intact. The animals were killed from three to five days after the last operation, and the operation was checked by autopsy. The possibility of nerve fibers reaching the muscle from regenerating stumps is considered remote, as the only animal which showed a suggestion of nerve regeneration at autopsy was excluded from the series. In another series of cats, the inferior cervical ganglion and the posterior roots and ganglia of the sixth cervical nerve were removed on one side. These animals were killed after from twenty to thirty days. Pieces of both denervated and normal muscles from the fixed preparations were stained by the Bielschowsky method.

The sensory terminations on the intrafusal muscle fibers consist of a very delicate neurofibrillar network applied on the sarcolemma. The inactivity or rest of the muscle does not appear to alter the constitution and muscle-nerve relation in the neuromuscular spindle. Differential nerve degeneration after complete isolation of three nerve roots shows that neuromuscular spindles in the flexor digitorum sublimis and profundus muscles of the cat may be monosegmentally, bisegmentally and trisegmentally innervated. In cases of plurisegmental innervation, consecutive segments of the spinal cord contribute in supplying the spindle. The author confirms the presence of somatic motor terminations in the intrafusal muscle fibers.

ADDISON, Philadelphia.

ONTOGENY OF EMBRYONIC BEHAVIOR IN AVES: II. THE MECHANICAL FACTORS IN THE VARIOUS STAGES LEADING TO HATCHING. ZING YANG KUO, J. Exper. Zool. **62**:453 (July 5) 1932.

In order to be properly situated for hatching, the bird embryo must pass the following critical stages: (*a*) orientation; (*b*) torsion and flexion; (*c*) lying at the large end; (*d*) the stage of fixation of body position; (*e*) changes in the positional relations between the embryo and the yolk sac; (*f*) turning of the body so as to lie lengthwise of the egg, and (*g*) protrusion of the neck into the air chamber under the membranes. Failure to pass any one of these stages results in malposition, frequently accompanied by abnormal growth of the body and eventually ending in death in the shell. Most of the causal factors for the passing or failure to pass any of these critical stages are found to be mechanical. Changes in position of the embryo during the earlier stages are the result of forceful amnion contractions and yolk-sac movements. Increase in the weight of the embryo, the weakening of amnion contraction, the absence of albumin in the large end, the original orientation and the direction of distribution of the extra-embryonic blood vessels and the allantoic stalk and yolk stalk are the main factors causing the fixation of position. The coming of the yolk sac to cover the ventral side of the embryo depends on the contraction of the amnion and the absence of albumin in the large end. Low humidity, improper positions of the head and legs and the presence of albumin in the large end may prevent hatching. Complete enclosure of the yolk sac in the body cavity, the establishment of pulmonary respiration and the drying up of the membranes and of the shell must be accomplished before the chick is able to attempt to gain egress from the shell. The wriggling movements of the body, together with the upward thrusting of the legs against the shell, are respon-

sible for the rotation of the chick around the egg during hatching. The violent stretching movements of the neck with the aid of the leg thrusting against the shell separate the broken shell into two parts and effect the chick's escape.

WYMAN, Boston.

MORPHOLOGY OF CROSS-SECTIONS OF THE RETROBULBAR PART OF THE OPTIC NERVE. TEIKAI YATABE, Keijo J. Med. **2**:488 (Dec. 31) 1931.

The author finds that the appearance of the cross-section of the optic nerve is characteristic of the type of animal studied. The arrangement of the connective tissue septums is the distinguishing feature. In the cyclostoma the optic nerve is compact and has no connective tissue septum. In the fishes all grades of development, from very scanty septums to highly complicated structures, are seen. Thus, in the plagiostomas the nerve fibers do not form any definitely cohesive band, but are divided into a few bundles by fine connective tissue septums. In the teleostomas, such as the nematograth, a moderately thick connective tissue septum runs from the periphery to the center of the nerve trunk. The optic nerve in amphibia is primitive; the nerve masses are divided into bundles not by septums but only by glia fibers. In reptiles the structure is more complicated, with powerful septums running the length of the nerve. In birds a transitional stage is found between fish and mammals. In most cases a coherent structure of the optic nerve is found, with well developed secondary septums of about the thickness of the primary septums. In most mammals and in man the septal structure is highly developed. All the nerve bundles are independent. The law that the higher in the scale an animal is the more numerous and complete are the wrappings of the individual nerve bundles seems to find an exception in the fish which possesses a very complicated optic nerve. The primitive nerve is cylindric and compact, but in the higher animals differentiation into nerve bundles develops. In some mammals and in man a connection exists between the peripheral septums and the pia mater. Amyloid bodies were found in some birds and a few mammals. According to the author the arrangement of the glia cells differs with the animal species. In the more developed species there is an increase of the neuroglial element. In man the glia cells are somewhat more numerous near the surface of the individual bundles.

HART, Greenwich, Conn.

SULPHUR THERAPY IN THE PSYCHOSES. P. K. MCCOWAN, Lancet **2**:237 (July 30) 1932.

Forty-five patients were treated with sulphur. Of these, twenty-one gave advanced and thirteen early schizophrenic reactions; five had involutional melancholia, and six had a manic-depressive psychosis. A colloidal sulphur preparation and 1 per cent sulphur in oil were used. Supraperiosteal injections were given in the thigh on alternate days; ten injections were given, the initial dose being 1 cc. and the others 5 cc.

The conclusion from this series of treatments was that sulphur is in no way specific in treatment for the psychoses, but can be regarded as a useful addition to the type of treatment in which the setting up of a periodic pyrexia is the chief feature. It merits a trial in certain early cases of schizophrenia which do not respond to occupational therapy, and seems definitely useful in some cases of advanced schizophrenia in which the patients exhibit obnoxious habits or a temporary exacerbation of the psychosis. It seems to be useful in cutting short attacks of benign stupor. In the only melancholic patient of the manic-depressive type treated, it terminated an attack which had lasted for two years; but in involutional melancholia it was entirely without effect.

Repeated courses were not recommended as a routine measure, as no patient who failed to respond to the first course of injections benefited from subsequent courses, and it would appear unjustifiable in cases in which occupational therapy

is proving beneficial to interrupt this type of treatment by a further course of injections of sulphur. While it is possible that some beneficial biochemical changes are set up in the organism, there seems to be little doubt that the benefit which results from the treatment is largely, if not entirely, psychologic, and that the physical illness, with its pain and general discomfort, and the incidental nursing attention interrupt the fantasy life of the patient and force reality on him.

BECK, Buffalo.

POTENTIAL CHANGES IN THE ISOLATED NERVOUS SYSTEM OF DYSTICUS MARGINALIS. E. D. ADRIAN, J. Physiol. **72**:132 (June 6) 1931.

The nerve ganglia of insects show considerable spontaneous activity when completely isolated from the body. The discharges in individual nerve fibers can be detected without difficulty by amplifying the potential changes. In the thoracic and abdominal ganglionic chain of Dysticus marginalis, periodic outbursts may occur with the characteristic frequency of the respiratory movements. When these outbursts take place the ganglia develop a sustained negative potential with respect to the nerve. The potential change develops slowly and lasts throughout the period of discharge. It is absent in records made with both electrodes on the nerves.

The slow potential waves begin before the corresponding nerve discharge, but the frequency of the discharge is usually at its maximum when the potential change is greatest. The change proceeds smoothly and does not appear to be due to a summation of repeated active periods in different units. The waves are most probably due to a progressive depolarization and recovery in the dendritic region of the ganglia, the nerve discharge varying with the depolarization. As with the heart beat, the active periods in the ganglia are separated by intervals in which no potential change occurs. It is probable that the development of the "central excitatory state" in the respiratory neurons is not associated with any surface depolarization until it has reached a critical value.

The contractions of the body muscles in Dysticus, and in other insects, are due to trains of motor impulses which rise and decline in frequency in much the same way as in vertebrate muscles. Owing to the small number of motor units involved in any contraction each impulse series can be readily distinguished.

ALPERS, Philadelphia.

POLIOMYELITIS. IRVING J. SANDS, J. Nerv. & Ment. Dis. **75**:616 (June) 1932.

Anterior poliomyelitis is an acute infectious disease with the dominant pathologic process in the central nervous system, especially the anterior horns of the spinal cord and nuclei of some of the cranial nerves, particularly those situated in the medulla. The pathologic changes consist of marked meningitis, chromatolysis, neuronophagia and vacuolar degeneration of the anterior horn cells and nerve centers in the medulla, with areas of replacement of nerve cells with polymorphonuclear cells, lymphocytes and glia cells. There are marked inflammatory reactions in the area involved. The disease may appear in abortive forms and, as in the paralytic types, leave a permanent immunity. It tends to occur in epidemics; children under 10 years of age are chiefly affected. The initial signs and symptoms are those of marked meningeal and cerebral irritation, characterized by rigidity of the neck, headache, vomiting, constipation, marked elevation of temperature and general prostration. In about 25 per cent of patients paralysis soon appears. Treatment should be directed toward: neutralization of the virus by intravenous and intramuscular administration of serum from convalescent patients as soon as the diagnosis is made; reduction of cerebral edema by the administration of hypertonic dextrose solution intravenously and by spinal drainage; combating difficulties in respiration and in deglutition, and protecting the paralyzed muscles by proper mechanical support. The treatment of the paralysis should be directed by properly trained physicians and by competent nurses trained in orthopedic and physio-

therapeutic principles. Prophylactic measures during an epidemic may be advantageously utilized by segregating the child, and by administration of immune serum or whole blood intramuscularly. The latter procedure may be repeated every three or four weeks.

AUTHOR'S ABSTRACT.

MENTAL HYGIENE IN THE SCHOOL. WILLIAM H. BURNHAM, Ment. Hyg. **16**:26 (Jan.) 1932.

This is a reprint of an address delivered by Dr. Burnham in 1912, recalled on the occasion of his seventy-sixth birthday. Burnham emphasizes the fact that most patients in sanatoriums and hospitals for mental diseases have received many years of intensive training in the public schools, and that the school system cannot entirely escape the responsibility of having formed in these persons improper habits of thinking and reacting. To the end that psychic education would be more likely to succeed, he enumerates four principles of scholastic mental hygiene: 1. Children should be taught to be attentive; they should not be forced to display unnatural concentration, but allowance should be made for the natural lability of juvenile attention. 2. They should be taught orderly association, so that they may not be driven first into confusion and then into worry, anxiety or even obsession by their inability to associate ideas logically, sanely and proportionately. Violent interference with the child's normal associative processes by fatiguing drills, or by demanding quick answers under great pressure, must not be tolerated. 3. Wholesome outlets for emotional impulses should be provided rather than the introduction of a system for repressing these impulses. 4. Periods of rest should alternate with periods of work, the schedule being designed to coincide with the normal ebb and flow of attention in each case. Burnham deplores the exaltation of the disagreeable, the idea that unpleasant tasks are good discipline. He hastens to assure the more orthodox pedagog that he is not trying to make school work easier but that he is rather trying to make it at once harder and more enjoyable.

DAVIDSON, Newark, N. J.

TABES JUVENILIS. W. PIRES, An. assist. a psicop., 1931, p. 29.

Pires points out that in some interesting cases of tabes juvenilis the symptoms are manifested in children aged between 5 and 6 years. The differential diagnosis between hereditary ataxias (Friedreich's disease and Pierre Marie's heredo-ataxia) and tabes juvenilis is easy if one is dealing with typical forms, but difficult in the abortive types (*formes frustes*). There are also mixed forms of Friedreich's disease and tabes concomitant in the same person (Raymond). The tendon reflexes are found increased in heredo-ataxia and abolished in Friedreich's disease and in tabes juvenilis. In Marie's heredo-ataxia and in Friedreich's disease signs of the cerebellar series and the bilateral Babinski phenomenon are observed. In tabes infantilis there are no cerebellar symptoms, and the Babinski sign alone is observed in combined tabes. Further factors of the tabetic series are atrophy of the optic nerve, Argyll Robertson pupil and bladder disturbances. Examinations of the blood and the spinal fluid are of unquestionable importance in the diagnosis of tabes. The Wassermann reaction may be positive in the blood. In the cerebrospinal fluid it is almost always positive. Lymphocytosis and hyperalbuminosis may be observed. The Pandy, Nonne-Apelt and Weichbrodt reactions may be positive. The Lange reaction is nearly always positive, and the reaction to colloidal benzoin reveals a precipitation in the syphilitic area. The cases in which the humoral reactions are negative are rare. A systematic examination of the child, from the point of view of the pupillary reactions, eye fundus, tendon reflexes and serologic reactions for syphilis, will permit, without doubt, an early diagnosis. Specific syphilitic or malarial treatment will give relatively the best results.

EDITOR'S ABSTRACT.

ONTOGENY OF EMBRYONIC BEHAVIOR IN AVES: I. THE CHRONOLOGY AND GENERAL NATURE OF THE BEHAVIOR OF THE CHICK EMBRYO. ZING YANG KUO, J. Exper. Zool. **61**:395 (April 5) 1932.

By application of a thin coat of petrolatum, the inner shell membrane next to the air cell is rendered transparent; so continuous observations on the behavior of the avian embryo may be made without interference with the normal development of the embryo and without a change in the normal embryonic positions. The development of embryonic behavior in the chick begins from the head and progresses caudad. Every embryonic movement, after its first appearance, tends to persist until after hatching, unless it is modified by structural or environmental changes. Lifting and bending of the head are the first responses found in the chick embryo. These are later transformed into lateral turning of the head. Movements of the trunk appear in the later hours of the fourth day of incubation. Movements of the extremities are generally found by the end of the fourth day, and of the tail by the fourth or fifth day. Contraction of the amnion, movements of the yolk sac, and the swinging movement of the embryo begin by the end of the fourth day and increase in frequency and magnitude from the fifth to the ninth day. The frequency and magnitude of these movements begin to decrease from the tenth day, and they disappear after the fourteenth day. Oral movement begins on the sixth day. Movements of the eyelids are found on the seventh day, and movements of the eyeball on the eighth or ninth day. Responses to external stimuli, such as touch, pressure, sound, light and electricity, are found in the chick embryo at various ages.

WYMAN, Boston.

RECOVERY OF NORMAL TONUS IN THE COURSE OF REGENERATION OF THE CERVICAL SYMPATHETIC NERVE. HANS VON BRÜCKE, J. Comp. Neurol. **53**:225 (Aug.) 1931.

Regeneration after section and suture of the preganglionic cervical sympathetic trunk in twelve cats was studied histologically, and the fibers were counted. Regeneration of the most rapidly growing fibers was at the rate of 1 mm. a day. By two months the full number of fibers was restored. In one instance the normal number of fibers was found to be doubled at the end of four months. The effects of the operation, as soon as the anesthetic passed off, were: The pupil on the side on which operation has been performed was smaller; the nictitating membrane protruded, covering from one half to three quarters of the cornea; the lid slit was narrower, and the eyeball was sunk slightly back into the orbit. The vasomotor symptoms were flushing of the conjunctiva and dilatation of the blood vessels in the ear. The ear was red and warm as compared with the normally cool and pale ear of the other side. All these paralytic symptoms were observed quantitatively whenever possible, and their course was followed until recovery. It was found that a remarkably small number of nerve fibers was able to restore normal function in the peripheral organs. Two mechanisms are described which may account for this. The first is the development of "peripheral tonus" in the muscles—i. e., a certain amount of recovery originating in the peripheral organs themselves. The other is the spreading of impulses in the superior cervical ganglion. This allows a rapid restitution of normal innervation after partial section of the sympathetic nerve, before regeneration and without the development of "peripheral tonus."

ADDISON, Philadelphia.

THE BASAL CONNECTIONS OF THE FOREBRAIN AND MIDBRAIN WITH THE SENSORY TRIGEMINUS NUCLEI. A. WALLENBERG, Arch. f. Psychiat. **94**:246 (May) 1931.

The author reports the results of anatomic studies on the frontoquintal and the diencephaloquintal tracts in the duck, as well as the basoquintal part of the fasciculus "X" of Mayser in the goldfish and tench. In following up previous studies on this subject that he has been carrying on for years, Wallenberg finds

that in the duck there exists a centrifugal connection between the basal nuclei of the forebrain and the sensory trigeminus nucleus of the same side, in addition to the quintofrontal tract that leads from the sensory trigeminus nucleus to the frontal part of the base of the forebrain. The former appear to emanate from the frontobulbar tract in the frontal border of the midbrain, and run laterally and practically altogether into the dorsal three fourths of the sensory nucleus of the trigeminus nerve. Following injury to the ventromedial part of the entopeduncular nucleus of the duck there occurs a degeneration outside of the frontoquintal tract and also in the tract the fibers of which lead to the crossed trigeminus nucleus in the ventral quarter of it.

In the goldfish as well as in the tench, it was found that by producing a lesion in the basolateral part of the midbrain, where the thalamus, hypothalamus and ventral part of the tectum opticum meet, degeneration takes place in the centrifugal fibers of the ipsolateral fasciculus of Mayser, and also in the fibers to the nucleus of the spinal root of the trigeminus. These fibers may be considered as the "basoquintal part" of the bundle of Mayser. MALAMUD, Iowa City.

SYPHILIS: SOME PSYCHOLOGIC ASPECTS OF TREATMENT. GERALD PEARSON, Arch. Dermat. & Syph. **23**:1021 (June) 1931.

In the proper treatment for syphilis, the physician must develop a positive type of relationship with his patient—he must make an adequate psychologic approach. Cooperation is difficult to obtain, for patients are shocked when informed that they have syphilis, and may take the diagnosis too lightly or too seriously. An understanding of the problem must include recognition of the public's attitude toward the patient, the effect of this feeling on the patient and the reactions of the patient's spouse. In spite of the broadening of our moral code, syphilis is still regarded as a disgrace, for it comes under the sway of the emotional mechanisms associated with sex rather than under the control of reason or intellect. Pearson believes that the ordinary man despises the syphilitic person because he is envious of his sexual freedom and moral audacity. The diagnosis comes to the patient as a blow to his self-love, and consciously or subconsciously he considers it as a punishment for his indiscretions, even as a sort of poetic justice, for it suggests weakness of his sexual powers; to the patient it symbolizes castration. The diagnosis comes as a double blow to the patient's spouse, for it injures her pride by implying infidelity, and frightens her by implying contagion. Quarreling, bickering, fault finding and eventually marital rupture may result. Such a situation, apart from its physical effects, must wound the sensitive minds of the children in the family, with ultimately serious results. In the truest sense of that phrase, syphilis is a social disease. DAVIDSON, Newark, N. J.

CEREBROSPINAL FLUID FOLLOWING MALARIOTHERAPY. W. PIRES and C. LUZ, An. assist. a psicop., 1931, p. 3.

Pires and Luz state that during the past six years they have employed malarial therapy in more than 300 cases of neurosyphilis, and have reached the conclusion that it is without question superior to the therapeutic methods previously used, particularly in dementia paralytica. Examination of the cerebrospinal fluid immediately after malarial therapy does not, however, of itself furnish definitive evidence by which to form an opinion concerning the outcome of the treatment. The humoral remission is not evident until after the lapse of several months; the reaction may at first be weakly positive and finally negative. A patient cured clinically may still present positive reactions in the spinal fluid, but in a very attenuated degree. There is, after a year, a certain parallelism between the clinical remission and the humoral symptoms. Other authors say that complete integrity of the cerebrospinal fluid is not only late but rare, and that many cases of dementia paralytica regarded as cured present anomalies of the cerebrospinal fluid. A humoral syndrome that is irreducible by malarial therapy is a bad prog-

nostic sign, a new inoculation with malaria usually being necessary in such a case. A favorable change in a given inalterable morbid state has only a temporary character, and in a short time a return to the previous degree of positivity will occur. The patient with a negative cerebrospinal fluid and, at the same time, in a state of clinical remission does not ordinarily have a recurrence.

EDITOR'S ABSTRACT.

OBSERVATIONS ON TRIGEMINAL NEURALGIA. GEOFFREY JEFFERSON, Brit. M. J. **2**:879 (Nov. 14) 1931.

A complete and detailed review is given of trigeminal neuralgia from the standpoint of symptomatology, differential diagnosis and treatment. In regard to the symptomatology, the author summarizes as follows: "The patient is usually female, the pain is limited to one or two divisions save in the worst cases, the attacks are of brief duration, and between the pains the patient is moderately comfortable though apprehensive. There is a strong tendency toward remissions in which the pain is negligible or entirely absent for weeks or months. There is no alteration in the sensibility of the skin, certainly no diminution." Tic douloureux is considered a poor generic title for these conditions, because spasm is frequently absent, and when present, follows the pain but does not precede it. Differential diagnosis is mainly concerned with "atypical neuralgias," glossopharyngeal neuralgia, postherpetic neuralgia, tumors and gummas of the gasserian ganglion and local pathologic processes in the teeth and sinuses.

Alcohol injections are advised in cases in which surgical intervention is contraindicated. One injection prior to operation is to be considered to acquaint the patient with the numbness and the feeling of swelling which follow resection of the nerve or its roots. The operation of choice is to spare the motor root and the first division in practically all cases (the first division is rarely affected—2 per cent in the author's series).

FERGUSON, Nigagara Falls.

TREATMENT OF NONSYPHILITIC PSYCHOSES WITH MALARIA. M. LEVI-BIANCHINI and J. NARDI, Arch. gen. di neurol., psichiat. e psicoanal. **13**:121 (July 15) 1932.

The authors report the results of five years' experience with malarial treatment for nonsyphilitic psychoses, based on a study of 476 cases distributed in 14 groups. The report includes statistical data and describes the clinical course of the therapeutic fever; comparisons are made between the clinical character of the fever in dementia paralytica and in nonsyphilitic psychoses; the mechanism of action of the malarial inoculation in various syphilitic and nonsyphilitic psychoses is discussed. The conclusions are: 1. The clinical features and mechanism of action of therapeutic malaria in dementia paralytica and in nonsyphilitic psychoses may be considered as identical, or at least very similar. 2. Malarial treatment gave good results in about 25 per cent of cases of schizophrenia and in about 44 per cent of cases of manic-depressive psychosis; about 10 per cent of good results were obtained in the group of cases comprising acute and chronic postinfective, arteriosclerotic and endogenous psychoses; the treatment failed to bring favorable results in epilepsy, in postencephalitic bradyphrenia and in oligophrenia. 3. The malarial treatment is indicated in all psychoses associated with general psychomotor excitement. The treatment is safe and often brings about a great improvement in general metabolism. 4. On these grounds, malarial therapy should have a place in psychiatric practice as a routine method of treatment for many mental diseases.

YAKOVLEV, Palmer, Mass.

SECONDARY VESTIBULAR TRACTS IN THE CAT. A. T. RASMUSSEN, J. Comp. Neurol. **54**:143 (Feb.) 1932.

The purpose of this study was to verify the origin of the secondary vestibular tracts and especially the existence or nonexistence of direct vestibulospinal fibers

in the medial longitudinal fasciculus. Small lesions, limited to the various subdivisions of the vestibular nuclei without damage to the reticular formation, were made by a wire knife. Few of the lesions were extensive enough to produce noticeable physiologic symptoms. After two weeks the brain and spinal cords were removed and prepared by the Marchi method.

The superior vestibular nucleus gives origin largely, if not entirely, to direct ascending fibers which occupy the extreme lateral portion of the medial longitudinal fasciculus from the level of the superior pole of the motor nucleus of the trigeminus, and up. The lateral nucleus, in addition to being the origin of a prominent direct lateral vestibulospinal fasciculus, is a probable source of direct fibers descending in the dorsolateral portion of the medial longitudinal fasciculus. Such fibers also arise from the region of the medial and descending vestibular nuclei. The latter also gives rise to many crossed ascending and descending fibers in the medial longitudinal fasciculus. All these descending fibers in the medial longitudinal fasciculus terminate largely above the lumbar region of the spinal cord. Fibers from the cortex of the vermis mostly to the opposite nucleus fastigii are verified. No evidence was found for a crossed vestibular root.

Some practical hints to facilitate the handling of large series of blocks in the Marchi method are detailed.

FRASER, Philadelphia.

"DIVINITY" IN SEMEN. THEODORE SCHROEDER, J. Nerv. & Ment. Dis. **76**:110 (Aug.) 1932.

The author has made a study of early Christian and primitive religious cults and customs and finds the belief that the semen is Divine Power in concentrated form recurring in a variety of ways. The ancients frequently regarded semen as the seat of the soul and the testes as sacred organs. The book of Genesis gives an example of some of the patriarchs swearing solemn oaths by placing the hands on the testes. This custom has even survived in some Welsh laws of rape enacted by Hoel the Good. According to Knight, the gnostics offered semen in the sacrament as representing concentrated essence of God. The Eucharist is made from the seed of corn and the seed part of grapes to illustrate this seminal and creative significance. The same use of semen was found among the sect of the Manichees. Avicenna and Sinnertus claimed that the human soul existed in the seed. The Rev. Thomas Vaughan (1622-1666) connected sex union with the union of Christ. Hare, in his studies of Indian customs, found the belief of the spirituality of man and the soullessness of woman related to the conception of the power of the semen. Fellatio, as in eating of the sperm, has frequently been regarded as a means of obtaining immortality, and in this way exaltation might become a substitute for the depression of guilt. The author concludes with the belief that religious love, divine love and sex love might be found to rest on the same psychophysical facts and to differ only in valuations assigned to them.

HART, Greenwich, Conn.

LESION OF THE FOUR LAST CRANIAL NERVES ON THE LEFT SIDE. A. BACELAR, Rev. Assoc. paulista de med. **1**:280 (April) 1932.

Bacelar reports the case history of a woman wounded by a firearm. The bullet had entered the left canine fossa and traveled in an anteroposterior direction without penetrating the buccal or pharyngeal cavities; it was arrested in the soft tissues of the neck behind the posterior border of the mastoid. The patient presented: (1) left-sided paralysis of the tongue, the soft palate, the constrictor muscles of the pharynx, the larynx and the sternocleidomastoid and trapezius muscles; (2) loss of taste in the posterior part of the left side of the tongue, loss of sensation in the soft palate, the pharynx and the larynx, and (3) abundant pharyngeal secretion and tachycardia up to 140. Consequently the injury involved the glossopharyngeus, vagus, accessorius and hypoglossus nerves. Fifteen days later a second examination disclosed the same symptoms, except that the pulse rate had dropped to 110. One month and a half after receiving the injury the patient complained of loss of strength in the left arm, stating that it felt as if it were asleep. Reexami-

nation showed marked atrophy of the tongue and the sternocleidomastoid and trapezius muscles, and the existence of an aneurysm 1 cm. behind the mastoid process, proving that the internal carotid had been injured. This aneurysm was the probable cause of the disturbance in the patient's arm from pressure on the brachial plexus. The patient disappeared from observation after she left the hospital.

EDITOR'S ABSTRACT.

DERMATOSES ASSOCIATED WITH NEUROCIRCULATORY INSTABILITY. S. W. BECKER, Arch. Dermat. & Syph. **25**:655 (April) 1932.

This is a study of 204 patients with dermatoses without organic lesions—the so-called functional dermatoses. The diseases in this group include pruritus, neurodermatitis, urticaria, alopecia areata, lichen planus and angioneurotic edema. Becker is inclined to doubt the allergic nature of these conditions, pointing out that relief in a different climate or under hospital care is more likely due to a change in the psychic environment than to alterations in diet or inspired dust. The dermatoses in this group are commoner in women and are more frequently seen in the higher social and intellectual strata. A family history of constitutional instability of one kind or another is common; and patients who may seem cool and calm to the casual observer are frequently found on more careful study to have a very unstable neurocirculatory system. The basal metabolic rate is usually high, but second and third readings are likely to show much reduction. In children the marked features of the dermatosis are restlessness, insomnia and emotional instability. Adults of this type are ambitious, hard working and wide-awake but easily fatigued persons who work by fits and starts, and who are disproportionately moved by trivial events. Treatment is directed to the whole body and not to the skin, although mild local applications may be used. Roentgen therapy and cutaneous tests are discouraged. Precipitating factors should be removed and relaxation provided by longer luncheon hours, quieter vacations and other means.

DAVIDSON, Newark, N. J.

CHANGES IN THE SECTIONAL AREAS OF THE LARGEST FIBERS IN THE FIFTH LUMBAR SPINAL NERVE AND ITS ROOTS IN THE ALBINO RAT. K. IDE, J. Comp. Neurol. **53**:479 (Dec.) 1931.

In a previous paper Ide found that the areas of the largest root fibers in the sciatic nerve at preganglionic level were greater than the areas of the largest fibers distal to the ganglia. This raised the question of the change in the sectional area of these fibers during their course. The material for this study consisted of both fifth lumbar nerves, from twelve male and ten female albino rats. The specimens were fixed in osmic acid and treated as in the previous study. In each section the thirty largest fibers were measured. The results of the study show that: 1. The area of the largest fibers is greater in the ventral than in the dorsal roots; in the males by 15.2 per cent and in the females by 21.1 per cent. 2. In the ventral root of the fifth lumbar nerve the largest fibers show a continuous decrease in area from their exit from the cord as they pass distad, whereas in the dorsal root of the same nerve the largest fibers increase in area from the level nearest the ganglion until they enter the spinal cord. There is thus conical diminution in the ventral root fibers, but the reverse condition is found in the dorsal root fibers. No explanation of the latter condition is attempted. The author believes that these relations could probably apply to other spinal nerves of the albino rat and to some other mammals also. He suggests that under the conditions present the rate of speed of the nerve impulse within a single fiber would show frequent fluctuations.

ADDISON, Philadelphia.

CONDUCT DISORDERS IN SYPHILITIC PATIENTS. JACOPO NARDI, Ann. di nevrol. **45**:107 (July-Aug.) 1931.

Headache and a state of depressive hypochondria, which are often among the early manifestations of syphilis, indicate the initial phase of somatopsychic altera-

tion of the central nervous system. From this may result severe organic changes, giving rise to tabes or dementia paralytica, or to pure, more or less grave, mental disturbances ranging from simple dysthymic conditions to psychoses, such as manic-depressive psychosis, syphilitic hallucinosis of Plaut, syphilitic paranoia of Kraepelin and syphilitic paraphrenia of Bumke, and schizophrenia. The latter syndromes may be encountered without neurologic signs indicating the existing syphilitic cerebral involvement. (It is not unreasonable to suppose that a true schizophrenic or a manic-depressive patient may also be suffering from syphilitic involvement of the central nervous system, the two conditions remaining more or less distinct.) Among the psychic alterations found in syphilitic persons, changes in the personality, conduct disorders and disturbances of the will, with aridity of affects, criminal impulses, sexual perversions and dulling of the moral sense, are frequently met. These grave disturbances frequently lead the sufferer to conflict with the law, and he is often punished unjustly because the cause of his abnormal behavior is not recognized. The author carefully describes two cases of syphilitic conduct disorders.

IMPASTATO, New York.

IS IT TO THE ADVANTAGE OF THE MENTAL HOSPITAL TO MAINTAIN A SCHOOL OF NURSING? WILLIAM L. RUSSELL, Ment. Hyg. **16**:56 (Jan.) 1932.

Pointing out that the half million patients in hospitals for mental diseases today need more intelligent care than can be afforded them by untrained attendants, Russell pleads for the establishment of nurses' training schools in these hospitals. The affiliation of students in general hospitals for a short psychiatric course he rejects as inadequate, and postgraduate training as demonstrably unattractive. The change from the madhouse to the hospital for mental diseases, from custodial care to active therapy and from brutal management to sympathetic handling must be accompanied by a shift in the active caretaker of the patient from the attendant to the nurse. The solving of the medical and surgical problems of the mentally ill, the introduction of intelligent charting and record keeping and the operation of physical therapeutic technics all demand the skilled hand of the trained nurse. Furthermore, training in a hospital for mental diseases will not leave a nurse unequipped to care for any one but an insane patient; it will rather give her a grasp of the patient as an integrated personality. Finally, mental hygiene will make inadequate headway until the nurses who come into primary contact with the problem child and the problem adult receive proper training for this work.

DAVIDSON, Newark, N. J.

EFFICACY OF THE RAT'S MOTOR CORTEX IN DELAYED ALTERNATION. R. B. LOUCKS, J. Comp. Neurol. **53**:511 (Dec.) 1931.

Observations were made on the achievements, in a special form of problem box, of two groups of rats that had been partially decorticated. The first group of animals had received training before decortication, and the second group had not. In group 1, eighteen of twenty-three rats relearned the problem subsequent to operation, but took a longer time than in the initial training, when they were in a normal condition. In group 2 only fourteen of twenty-five learned the problem, but the successful animals learned in about the same number of trials as the post-operative animals in group 1. With regard to the general level of performance, in the opinion of the author, it seemed better never to have learned than to have learned and lost. The problem box was constructed so that the rats could be trained to alternate right and left in ten successive choices, with a delay of fifteen seconds between choices. The amount of neocortex removed in the eighteen that relearned in group 1 varied from 9 to 31 per cent, and in the five that did not relearn, from 17 to 43 per cent, while the amount removed in the fourteen that learned in group 2 varied from 17 to 31 per cent, and in the eleven that did not learn, from 17 to 36 per cent. The author thinks that there is no significant relation between the extent of lesion and performance, within the limits used in this study.

ADDISON, Philadelphia.

THE PROBLEM OF THE CEREBRAL MUSCLE ATROPHIES. G. MARINESCO, A. KREINDLER and E. FAÇON, Arch. f. Psychiat. **93**:222, 1931.

The results of investigations in a case in which muscle atrophy occurred following a cerebral insult are summarized as follows: There were functional disturbances of the vegetative centers of the midbrain, as evidenced by increased sugar tolerance, a change in the blood sugar curve, a diminution of the concentration capacity of the kidneys and irritability of the whole vegetative system. The asymmetric reaction to different pharmacodynamic tests was indicative of disturbances of the sympathetic system.

The authors also found changes in the nerve-muscle chronaxia relationships. The chronaxia of the muscles seemed to be decreased, whereas the chronaxia of the nerves retained normal value. The authors believed that these disturbances in the irritability of the muscles were due to metabolic changes in the muscle tissues.

They conclude with the statement that apparently some pathologic processes of the cerebrum are accompanied by anatomic or physiologic changes in the vegetative centers of the midbrain. These changes cause disturbances in the interrelationships of the endocrine system. These produce changes in the local sympathetic tone of the organs, bringing about the metabolic disturbances in them.

MALAMUD, Iowa City.

INORGANIC CONSTITUENTS OF THE CEREBROSPINAL FLUID: III. MAGNESIUM AND CALCIUM IN MENINGITIS. ROBERT ALEXANDER MCCANCE and ELSIE WATCHORN, Brain **45**:91 (March) 1932.

The magnesium content in the cerebrospinal fluid, which is higher than the magnesium in the blood serum or plasma, cannot be explained on the basis of ultrafiltration. Previous workers have found a constancy of the magnesium in the cerebrospinal fluid. In thirty-three cases of meningitis, with forty-six separate samples of cerebrospinal fluid, there was a tendency for the magnesium to fall; this was paralleled by the chlorides. The authors do not give the values for blood chlorides, which may lead one to question the acceptance of the fall in the chlorides of the cerebrospinal fluid as an absolute one. This decrease was not present in any of the acute cases, and the magnesium in the serum did not fall with the cerebrospinal fluid magnesium. The serum calcium averaged 10.1 mg. per hundred cubic centimeters, and the corresponding cerebrospinal fluids, 5.84 mg. The meningitic serum-cerebrospinal fluid calcium ratio was 0.577 and the nonmeningitic one, 0.543. A fall in the cerebrospinal fluid magnesium, which has been the rule in chronic meningitis, would seem to be of diagnostic value. The authors conclude that magnesium in the cerebrospinal fluid is normally fixed at a definite level by some active cellular process.

MICHAELS, Boston.

THE APPARENT EFFECTS OF CEREBRAL TUMOR ON AUDITORY ACUITY. LAWRENCE J. LAWSON, Arch. Otolaryng. **15**:583 (April) 1932.

A case is reported in which a tumor replacing the white matter of the left hemisphere, extending from a section through the anterior commissure backward to a section through the posterior quadrigemina, was accompanied, as the chief symptom, by progressive loss of hearing in the left ear over a period of a year. Following a sudden convulsive choking attack, with slight weakness on the right side, there was marked loss of motor speech, mental fogging and marked paresis of the right side. There was no evidence of pressure in the disks or spinal fluid. The course of the auditory fibers is discussed, and the following opinions from the literature are noted: Dandy had never seen a cerebral tumor producing loss of auditory function. Crowe stated that it is rare for cerebral tumors on either side to involve hearing. In his experience a lesion above the tentorium does not affect the hearing if one temporal lobe is intact. McClintic believes that cerebral lesions affect auditory acuity. Misch reported a case involving Flechsig's

area with impairment of hearing, and concluded that lesions lying medially from the anterior transverse gyrus may cause deafness through the destruction of the auditory radiation, which runs laterally into the medullary substance, without necessarily destroying the entire auditory cortex. HUNTER, Philadelphia.

THE PLAY OF ANIMALS. BASTIAN SCHMID, Fortschr. d. Med. **50**:615 (Aug. 5) 1932.

The author finds two roots in play activities, the physical and the psychic. The former was particularly stressed by Herbert Spencer and A. R. Wallace, who considered that play is due to a superabundance of energy which demanded a physically active outlet. The other root of play activity, the psychic, is, according to the author, an expression of the life habits and psychic organization of the animal; hence the play of the carnivorous animal is not identical with that of the herbivorous, but resembles the instinctive productivities of the mature animal. Play is thus an expression of these activities in the form of purposeful preparation. He describes in detail the stalking and springing of a young kitten on a ball of wool as preparatory to the mature hunting activity. Often this play activity is indulged when the animal is otherwise exhausted. Apes play with small objects because of their interest in all objects of their environment. The author makes similar observations on weasels, squirrels and birds.

HART, Greenwich, Conn.

THE VESTIBULOSPINAL SYNDROME. A. SUBIRANA, Encéphale **26**:615 (Sept.-Oct.) 1931.

After presenting considerable discussion from the literature on the characteristics of the vestibulospinal syndrome, the author lists a number of definite points to be considered in making this diagnosis: 1. "Petit pas" is a very accentuated type, oftentimes with as many as eighteen or twenty steps in a distance of 3 meters. 2. Movements do not show marked incoordination or dysmetria, and cerebellar tests ordinarily give negative results. There is usually no dragging of the feet, each foot being lifted completely off the ground. 3. All pyramidal tract signs, both of an irritative and inhibitory type, are negative. Barré's sign is negative. 4. There is a remarkable constancy of a deficit in the action of the psoas muscle. 5. When lying in bed, the patient can move the inferior members practically the same as can a normal person. 6. The patient lying in the dorsal or ventral decubitus cannot pass unaided to another position. The author believes that this symptom has not previously been described.

ANDERSON, Los Angeles.

NEURITIS OF THE AUDITORY NERVE OCCURRING DURING INTRAVENOUS ARSENIC MEDICATION. HARRY ROSENWASSER, Arch. Otolaryng. **15**:284 (Feb.) 1932.

The author gives an excellent review of the toxic effects of arsenic from accidental and from therapeutic exposure. He calls attention to a case of sudden deafness following injections of iron and arsenic given by the family physician as a tonic. A patient with psoriasis was given one intramuscular injection of 5 cc. of iron and arsenic and then a series of intravenous injections of the same preparation twice weekly until six or eight injections had been given, when he told the physician that he had noted loss of hearing in the right ear two weeks before. The attending physician, not realizing the cause, gave another injection, following which the patient had total loss of hearing in the right ear. Three weeks after the last intravenous injection the hearing began to improve. The urine still showed the presence of arsenic. Eventually the hearing was completely restored. The author warns that during the administration of any of the heavy metals, especially intravenously, the hearing apparatus should be carefully watched.

HUNTER, Philadelphia.

REPORT OF AN ANALYSIS OF ERRORS IN WRITING DURING THE YEARS FROM 1915 TO 1929. JAKOB BILLSTROM, Acta psychiat. et neurol. **6**:443, 1931.

From 1915 to 1929, the author kept a record of all the mistakes he made in writing. The mistakes are arranged according to Meringer's classic table, but the following groups are added: (1) Berg's theory of attraction of letters; (2) Freud's theory of psychogenic errors, and (3) Billstrom's theory of the effects of the shifting of sounds, or the so-called high German consonant-shift. The last mentioned group—one of the more important—has been thoroughly analyzed, and is to be found in letters of literate persons and young people, though it is not found in correspondence of the illiterate or among the spelling mistakes made by young children. After the age of 45, the usual anticipations become less frequent, while the postpositions and some others increase in number (probably because of a tendency to perseveration), both relatively and absolutely. According to the author's record, this increase became still greater after serious dysentery in 1928 and an emotional shock in 1929. Apart from parallelism, the psychogenic mistakes in writing are of little or no importance.

PEARSON, Philadelphia.

AMPHIBIAN FOREBRAIN: V. OLFACTORY BULB OF NECTURUS. C. JUDSON HERRICK, J. Comp. Neurol. **53**:55 (Aug.) 1931.

The material studied was the eighty-nine specimens of adult Necturus which were used by Dr. Herrick in contributions on the brain of Necturus over a period of seventeen years. The histologic elements of the olfactory apparatus appear less highly specialized than in higher Urodeles. The mitral cells of the olfactory bulb are large and voluminously branched, and most of them are of irregular form with large recurrent dendrites arborizing among the granules. The granules are numerous and of the simplest possible structure. The limits of the bulbar formation are morphologically well defined. The olfactory bulb is permeated by a dense neuropil composed of short axons and collaterals of longer axons which continue backward without interruption into the secondary olfactory nuclei. This neuropil is a field of diffusion and intensification of olfactory nervous impulses. Beyond the bulbar formation it receives an increasing number of fibers of non-olfactory systems, thus serving as an elementary apparatus of correlation.

ADDISON, Philadelphia.

INTRACRANIAL ANEURYSM INJURING CRANIAL NERVES. BAILLIART, MONTAIS and SCHIFF-WERTHEIMER, Ann. d'ocul. **168**:931 (Nov.) 1931.

Bailliart, Montais and Schiff-Wertheimer report a case of the Collet-Sicard syndrome in a man, 53 years of age. Deafness in the right ear was associated with slight bilateral exophthalmos, disorders of the extrinsic muscles and bilateral papilledema. On auscultation of the right mastoid region a reenforced systolic murmur was heard. The general arterial pressure was 250 systolic and 120 diastolic, and the diastolic retinal blood pressure was 150. The case is probably one of arteriovenous aneurysm, but it is difficult to diagnose its exact location. In discussion, Morax expressed astonishment that there was a high retinal arterial pressure in such a case. From the therapeutic standpoint he had obtained excellent results in two cases of traumatic arteriovenous aneurysm by injecting gelatinized serum.

BERENS, New York.

THE BIOLOGICAL SIGNIFICANCE OF EXTRA-PYRAMIDAL SYNDROMES APROPOS A CASE OF WILSON'S DISEASE IN THE ADULT. R. MOURGUE, J. Neurol. & Psychopath. **12**:97 (Oct.) 1931.

Mourgue, on the basis of extensive clinical investigation of a case of Wilson's disease, discusses the biologic significance of extrapyramidal syndromes. He is particularly impressed by the organovegetative nature (secretory, metabolic, vasomotor and trophic) of the symptoms, their variability and frequency. By the

vegetative system he means not only the sympathetic and parasympathetic nervous systems but also the electrolytes, the hormones and the colloidal balance. In addition, the case presented a series of motor phenomena remarkable for their variability and distinguished by extreme fatigability. Fatigue, the author states, is an index of disregulation supervening in the relation of the vegetative and the animal life, its starting point being the vegetative system. Extrapyramidal syndromes result "from disorder of coordination between afferent and efferent impulses," and can be produced by lesions at different neural levels.

SPERLING, Philadelphia.

FRIEDREICH'S SYNDROME. FLAMENT, J. de neurol. et psychiat. **31**:529 (Aug.) 1931.

The author presents a case which he describes as Friedreich's syndrome rather than as Friedreich's disease, because of the lack of familial antecedents. Symptoms began in the patient at the age of 23½ years, which the author considers as unusually late for the development of this condition. The progress of the disease was rapid, so that one and one-half years after the development of the symptoms the patient was almost completely incapacitated. Examination revealed diminished muscular tone, loss of tendon reflexes, loss of abdominal reflexes and a bilateral Babinski sign. Muscular movements were decidedly ataxic. There was a slight nystagmus on lateral rotation in both directions. Speech was said to be of cerebellar type. Spinal curvature and Friedreich's foot were present. The author concludes that this is not a case of Friedreich's ataxia, but rather a condition of spinal cord change following an inflammatory process similar to multiple sclerosis.

WAGGONER, Ann Arbor, Mich.

EPILEPSY AND GUNSHOT WOUNDS OF THE HEAD. W. E. STEVENSON, Brain **54**:214 (June) 1931.

Sargent, in 1920, found that in 4.5 per cent of 18,000 cases of wounds of the head epilepsy had developed. The author found 11 cases in which ten years or more intervened between the trauma and the onset of definite epilepsy, the longest interval being fourteen years. In 84 cases of old gunshot wounds of the head, 57 patients were definitely epileptic, 9 had vertiginous attacks, 12 had emotional outbursts and in 6 cases the condition was not diagnosed. Vertigo is more common in traumatic than in idiopathic epilepsy; epileptic equivalents are less common. In relation to mental deterioration, the type and frequency of the fits seem to be more important than the site and the severity of the wound of the head. The types of disorder encountered in different locations of the brain are described. With superficial wounds, the epileptic predisposition or nervous instability plays a larger part in the production of fits.

MICHAELS, Boston.

THE VASCULAR SUPPLY OF THE ARCHICORTEX OF THE RAT: II. THE ALBINO RAT AT BIRTH. E. H. CRAIGIE, J. Comp. Neurol. **52**:353 (June) 1931.

This study was made on the brains of five new-born male albino rats into which carmine gelatin was injected. The author finds that the capillary richness in the hippocampal formation in these animals is less than in the adult, and that the differences in vascularity of the seven laminae are less prounounced and do not correspond exactly with those in the adult. The capillary supply is less rich than in the neocortex, except in the molecular layer. In the fascia dentata the molecular layer is poorer than in any part of the neocortex except the insular cortex. The author observes no sign of precocious development of the archicortex even in comparison with the visual cortex, and deduces that the hippocampus is probably not concerned to any important extent in the early responses of the animal to olfactory stimuli.

ADDISON, Philadelphia.

HAS TIC DOULOUREUX A DEFINITE ETIOLOGY? CHARLES WARD ELLIS, Arch. Otolaryng. **15**:218 (Feb.) 1932.

The author reports eight cases in which a similar involvement of the maxillary sinus on the affected side was present and was recognized by antroscopy, although roentgen rays, nasal examination and transillumination failed to reveal them; no pus and no catarrhal symptoms were present. In each of these cases polyps were found in the maxillary sinus. The cases were consecutive. The author suggests that the "neuralgia may be due to a toxic condition of the sinus contents or to pressure on the exposed nerve of the second division through a dehiscence." All of the author's cases were of asymptomatic sinusitis. The patients were cured by either a window resection or by a Caldwell-Luc operation. Complete exenteration of the mucosa is advised.

HUNTER, Philadelphia.

NORMAL ASYMMETRY AND UNILATERAL HYPERTROPHY. GEORGE HALPERIN, Arch. Int. Med. **48**:676 (Oct.) 1931.

The two halves of the body in mammals are never really symmetrical. Ordinarily, the skull, brain, face, breast and lower extremity are larger on the left side, while the vertebrae, ribs, arm and forearm are commonly larger on the right. On the right, the ear, eye and nipple are usually a little higher than on the left. These asymmetries are normal and can be detected only by careful measurement. Gross inequality of the sides, obvious to the naked eye, is rare. Halperin presents a case in which asymmetry was striking, the patient being larger on the left. The literature was reviewed, and only fifty-nine cases of unilateral hypertrophy were found; the author's case is the sixtieth. Although all cases were of congenital origin, hereditary influences were not conspicuous.

DAVIDSON, Newark, N. J.

LESIONS OF THE CENTRAL NERVOUS SYSTEM CHARACTERISTIC OF PELLAGRA. ORTHELLO R. LANGWORTHY, Brain **54**:291 (Sept.) 1931.

In previous studies, fatty and pigmentary changes have been observed in the small cerebral arterioles and capillaries, with hyaline deposits, particularly in the capillaries. Pigmentary atrophy, an expression of profound nutritional changes, occurs in the nerve cells. A pseudosystematized degeneration of the anterolateral columns of the spinal cord occurs in many cases. In general the changes in the nervous system are diffuse and are supposed to be of toxic origin. A clinicopathologic description of a typical case of pellagra complicated by tuberculosis of the lungs and intestines is given. Marked pigmentary changes were found in the cells of the autonomic and sensory ganglia, and in the spinal cord and brain stem.

MICHAELS, Boston.

TWO CASES OF TUMOR OF THE HYPOPHYSEAL REGION. J. L. PAVIA, Rev. d'oto-neuro-opht. **9**:743 (Dec.) 1931.

The cases are reported with the object of drawing attention to the ophthalmologic findings and of emphasizing the value of an examination with *"aneritre"* (red-free) illumination. In both cases there were: marked cupping of the disks, hemianopia, degeneration of the retinal fibers, signs of dyspituitarism and increase in the size of the sella turcica. One of the patients was operated on by the transfrontal route under local anesthesia, and a tumor as large as a nut was removed with the electric knife and by aspiration. The other case was deemed inoperable. The article is illustrated by photographs of the eyegrounds, roentgenograms and tracings of the visual fields.

DENNIS, Colorado Springs.

THE DECLINE OF ABILITIES WITH INCREASE IN AGE. GERTRUDE EHINGER, Arch. de psychol. **23**:67, 1931.

In a previous study of the motor capabilities of working women, the author found that their abilities began to decrease shortly after the age of 30. This

study is a continuation of the former. Similar tests of mechanical aptitudes were applied to 152 women of a higher intellectual and occupational standing, and the results were compared with the former group. It was found that a similar decline took place. In the first group the decline began at about the age of 30; in the second, at about the age of 35.

PEARSON, Philadelphia.

A CASE OF CEREBELLAR HEREDO-ATAXIA. P. VAN GEHUCHTEN, J. de neurol. et psychiat. **31**:560 (Sept.) 1931.

The case reported is that of a girl, aged 20, who had a younger sister showing essentially the same complex. The patient's symptoms began at 6 years of age, with progressive development of cerebellar disturbances: hypertonia, dysmetria, intention tremor, marked nystagmus and some diminution of tendon reflexes, but there was no loss of abdominal reflexes and the plantar reflexes were normal. The author considers the condition similar to Friedreich's disease, explaining that the symptoms are purely cerebellar in origin.

WAGGONER, Ann Arbor, Mich.

THE EFFECTS OF EXTRACTS OF THE MAMMALIAN HYPOPHYSIS UPON IMMATURE SALAMANDERS. ROBERT K. BURNS, JR., and ADRIAN BUYSE. Anat. Rec. **51**:155, 1931.

This article reports a nice piece of work showing that the hypophysis-gonad reproductive tract interrelationship, familiar in mammals, prevails also in amphibians, and probably in most vertebrates. In several groups, extracts of hypophysis are interchangeably active. In females the size of the ovaries is not greatly affected, but there is premature entry of many young ovogonia into the growth stage. In male larvae there is a remarkable hypertrophy of the testis, accompanied later by the premature onset of spermatogenesis.

COBB, Boston.

TREATMENT OF CHRONIC EPIDEMIC ENCEPHALITIS BY FEVER THERAPY: RESULTS OF AN EXAMINATION OF PATIENTS TREATED BY FEVER THERAPY BETWEEN 1920 AND 1929. G. HOGLUND and V. H. SJOGREN, Acta psychiat. et neurol. **6**:397, 1931.

From a study of eighty-three cases of chronic encephalitis in fifty-two of which fever therapy was administered and in thirty-one of which it was not administered, the authors conclude that in the treated patients the symptoms were less numerous and showed less tendency to progression, and that there were fewer deaths. They believe, therefore, that fever therapy is of value.

PEARSON, Philadelphia.

VAGOTONIC FORM OF EPIDEMIC NEURAXITIS. R. J. GUIRAL, Arch. de neurobiol. **12**:1, 1932.

Several cases are mentioned in which, after grip, marked vagotonic symptoms developed, together with symptoms of slight encephalitis. The author suggests a special localization of the encephalitis. In one case the diagnosis was corroborated by the results of inoculations in rabbits.

REFLEXES REGULATING NUTRITION. A. PI-SUÑER, Arch. de neurobiol. **12**:1, 1932.

This article presents a review of recent work on the reflex regulation of sugar, fat and albumin metabolism. The numerous contributions of the Spanish physiologist and his school are summarized briefly. Noteworthy is the proof of the rôle played by the spinal cord and sympathetic system in the production of hyperglycemia after ligation of the aorta and vena cava and after hemorrhage.

LORENTE DE NO.

Society Transactions

BOSTON SOCIETY OF PSYCHIATRY AND NEUROLOGY

TRACY J. PUTNAM, M.D., *Secretary*

Regular Meeting, Nov. 17, 1932

W. J. MIXTER, M.D., *in the Chair*

TWO CASES OF TUMOR OF THE BRAIN. DR. W. J. MIXTER.

CASE 1.—This man has had good general health. He had vomiting and suffered from epileptic seizures for several years. There were no localizing signs or history of localization, and no general signs except a rather low grade choked disk. Stereoroentgenograms gave positive evidence of a neoplasm in the form of a calcified area in the left hemisphere. This was in the area of speech and word perception, but so far as is known he had had no disturbance from it. He had a severe headache and showed a little delay in word perception and the naming of objects on the day before the operation, and on that day he had a little flattening of the face. The tumor protruded from the surface of the cortex. It could not be entirely removed, but perhaps two thirds of it was removed by suction and electrosurgical operation. There is no paralysis now, and he speaks fairly well.

(DR. C. S. KUBIK: The tumor is unquestionably a glioma, but it has not been classified yet.)

CASE 2.—This man had a destructive lesion of the bone in association with a typical meningioma in the left frontotemporal region. There was a typical picture of meningioma protruding through the bone and involving the scalp. It was decided to take out the bone, boil it and put it back again. This was done January, 1931; the dura was replaced by fascia lata and the bone sutured in place again. He has a draining sinus and slight headache, but gets around fairly well.

PARAVERTEBRAL INJECTIONS: PRESENTATION OF CASES. DR. JAMES C. WHITE.

I have been interested for a long time in the new application of the injection of procaine hydrochloride and alcohol in cases of angina pectoris. I find that one can permanently block the sympathetic ganglia, but can only temporarily paralyze the cerebrospinal nerves. The intercostal nerves usually begin to function again after from two to three weeks.

CASE 1.—Mrs. G., aged 56, has suffered from Raynaud's disease for twenty years. Her finger-tips were steadily cyanotic and acutely painful. One month ago, alcohol was injected under the first and second ribs on the left side by Dr. Smithwick. At the close of the injection he introduced a small amount of iodized poppy seed oil 40 per cent to show where the injection had gone. The changes in temperature were watched, and in ten minutes the temperature began to rise, coincident with the appearance of Horner's syndrome. One week ago, an operation was performed on the right side, and the ganglia were removed. She had a good deal of hyperesthesia when the alcohol was injected. The two methods resulted in approximately an equal degree of discomfort, and it is now a question as to which will be the more permanent.

CASE 2.—A man with extreme arthritis of the thoracic spine, who had had mild diabetes and had complained of lumbago for some time, slipped and wrenched

his back, for which he was admitted to the hospital two months ago. He was studied to see whether there was any evidence of malignant disease, but none was found. There was a high protein level in the spinal fluid (107 mg.), but nothing else abnormal was found. In spite of the negative findings we thought that there was probably a neoplasm somewhere; laminectomy was not considered to be warranted. Two weeks ago, we injected alcohol on the right side underneath the tenth, eleventh and twelfth ribs, with a little iodized oil afterward. He seems to have been relieved of the pain in the back, and the foot on the right side has remained dry and 10 degrees warmer. We cannot produce anesthesia of the large lumbar nerves, but we can block the lumbar sympathetic ganglia and their rami.

CASE 3.—This patient has mitral stenosis with auricular fibrillation. He has now had three peripheral emboli, the first causing gangrene of the left leg and amputation. Two weeks after the amputation, he experienced sudden pain in the right arm, and an embolism of the brachial artery was removed by Dr. R. Linton with relief. A week later, sudden pain appeared in the back and the left leg. We thought that the embolism was probably no lower than the bifurcation of the aorta. Dr. Linton opened the right femoral artery and tried to dislodge the embolus by passing a soft rubber catheter up the artery; this attempt was unsuccessful. The pain remained so severe that I then injected procaine hydrochloride around the lower four lumbar nerves. Within five minutes all pain had disappeared, so I injected 5 cc. of 95 per cent alcohol through each needle. This injection has resulted in permanent relief from the excruciating pain. We hoped that, by paralyzing the vasomotor nerves, we could cause also a sufficient increase in collateral circulation to prevent gangrene. This expectation was not realized, as the leg became gangrenous to the knee and had to be amputated at the middle of the thigh.

MULTIPLE NEURITIS: PRESENTATION OF A CASE. DR. G. COLKET CANER.

Mr. M., aged 20, an American, a clerk, seven days before entry experienced headache and pain about the shoulders, with some fever. Three days before entry, he complained of generalized weakness. The day before entry, he had a facial paralysis and was sent to the hospital as having poliomyelitis. Examination in the hospital showed weakness of the extremities, which was more marked in the legs. All tendon reflexes were lively. He complained of marked pain in the toes and of some paresthesia in the fingers; otherwise, examination gave normal results. Roentgen examination showed two infected teeth, and examination by a throat consultant revealed infected tonsils. No other infection was noted. The spinal fluid was slightly xanthochromic; there were no cells; the total protein was 450 mg., and other tests gave normal results. A diagnosis of infectious polyneuritis with facial paralysis was made. Two days after entry there developed paralysis of the left side of the face also. Repeated lumbar punctures have been done, with drainage of the spinal fluid. Recently he has been able to move the left side of the face somewhat, but the right side is nearly entirely paralyzed. He continues to have considerable pain in the toes, but the sensory changes have disappeared and strength is returning.

MULTIPLE NEURITIS: REPORT OF TWO CASES WITH AUTOPSY. DR. EDWIN M. COLE.

CASE 1.—E. J. G., aged 36, a white man, married, a teacher, was admitted to the hospital on July 29, 1931. He had been well until two weeks before admission, when he had a gastro-intestinal upset that lasted one day. Ten days before admission, he first noted severe aching pains in the legs, ascending on the following day to the muscles of the back and the neck. During the week before admission, the legs and then the arms became weak; he became progressively more unable to move. During the three days before admission, he had difficulty with articulation and swallowing, noticed a slight facial weakness on the right

and had occasional respiratory difficulty. During this period, a lumbar puncture revealed a pressure of 220, with 3 lymphocytes per cubic millimeter.

On admission, the patient was almost completely paralyzed; the temperature was 103 F.; the pulse rate, 95, and the respiratory rate, 40. He was able to perform a few slight movements with the fingers and had fair strength in the neck. He was unable to articulate or to swallow. There was a slight facial weakness on the right; the tongue was protruded in the midline. There was intercostal paralysis on the right, with good movements on the left. No further examinations or laboratory data were recorded.

Shortly after admission the patient began to have respiratory distress and was put in a Drinker respirator. The pulse showed weakness but responded briefly to stimulants. He died about twelve hours after admission, on July 30, 1931.

The diagnosis was acute poliomyelitis (Landry's ascending paralysis).

CASE 2.—F. A. H., aged 39, white, married, a native machinist, entered the hospital on March 10, 1932. He had been perfectly well until eight days before admission, when he went home from work feeling excessively tired and complaining of aching pains in the legs. Seven days before admission, he attempted to work but had to go home early because of pain in the legs. Six days before admission, the legs suddenly became so weak that he could not use them; strength never returned. Following this he had pain in the back and arms, after which the arms became paralyzed. Finally, the face became painful, and he soon was unable to move any part of the face. He had no difficulty in swallowing, speaking or breathing. Incontinence of urine appeared two days before admission. One day before admission, he was sent to the Chelsea Naval Hospital where a lumbar puncture was done. There were 18 cells, mostly lymphocytes; the colloidal gold test gave negative results; the sugar was 80 mg.; the Kahn reaction was negative; a smear gave negative results. A blood count was normal.

On admission, examination revealed an obviously sick man, with a temperature of 105 F., a pulse rate of 80 and a respiratory rate of 30. The positive findings were: (1) dilated pupils, nonreacting; (2) weakness of the muscles of mastication; (3) facial diplegia; (4) weakness of the sternocleidomastoid muscles; (5) deviation of the tongue to the right; (6) complete paralysis below the neck except for the diaphragm, the left elbow, which had slight power of flexion, and the right toes, which showed slight dorsiflexion; (7) tenderness on pressure over the muscles of the arms and legs, and (8) left biceps jerk, which was the only tendon reflex elicited. No further examinations or laboratory data were recorded.

A few hours after admission, the patient began to have respiratory difficulty and was placed in a Drinker respirator. For a while he seemed to do well, but about eight hours after admission the pulse became very weak, and he died on March 11, 1932.

The diagnosis was multiple neuronitis, with a question of poliomyelitis.

PATHOLOGY OF MULTIPLE NEURITIS IN THE PRECEDING TWO CASES (Lantern Slides). DR. CHARLES S. KUBIK.

The pathologic changes in the two cases are practically identical. The peripheral nerves show cellular infiltration, with possibly some increase in the number of Schwann cells in some places. The infiltrating cells are lymphocytes, large, round and polymorphonuclear, and there are also a few polymorphonuclear leukocytes. This cross-section of a peripheral nerve shows infiltration chiefly in the connective tissue of the nerve bundles, but it is present also in the substance of the nerve itself. The myelin is fairly well preserved. Some myelinated fibers are breaking up. The changes in the axis cylinders are much more striking, with fusiform enlargements connected by thinned-out portions of axis cylinders. The spinal ganglia show the same sort of infiltration as the peripheral nerves. The fiber tracts of the spinal cord are unaltered; they are rather pale, but the myelin sheaths can be seen under the microscope.

The anterior horns in case 1 present no very pronounced changes; some cells are slightly swollen, with a small eccentric nucleus; some have the appearance of an axon reaction; others are definitely shrunken. There were very few of

the small shrunken cells in this case, and no cellular reaction or glial changes. In case 2 the degenerative changes are more pronounced. All of the cells are rather small, and some are darkly stained; I doubt that all of them can be axon reactions, although there is nothing in the surrounding tissues to indicate a disease process. The axis cylinders of the anterior roots do not exhibit the same changes as the nerve roots and the peripheral nerves.

This disease is known as infectious polyneuritis or neuronitis. The chief changes certainly are in the peripheral nerves. I think that those of the anterior horn cells may be questioned. It is interesting that Dr. Mallory found the same sort of infiltration around the muscle of the heart. Some years ago Bradford and others injected matter from a case of this kind into a monkey; he claimed to have reproduced the disease. We failed to produce it with material from either of these cases.

POLYNEURITIS WITH FACIAL DIPLEGIA. DR. CHARLES A. MCDONALD.

The first paper on this condition was published in 1869, but the credit of acquainting the medical profession is given to Osler, who, in his textbook of 1892, under the article on neuritis, spoke of febrile neuritis with involvement of the facial muscles. Since then, many articles have been written under various terminologies, reporting many cases. In other words, the syndrome of polyneuritis and double facial paralysis is not new and is not uncommon. It is of interest that among our local physicians Walton referred to this condition years ago, and Taylor fittingly described it. Viets reported a case in much detail, with the pathologic observations and the results of examination of the spinal fluid. Taylor and I reported several cases and, although familiar with the idea of the relationship between encephalitis, poliomyelitis and polyneuritis with facial diplegia, were insistent on the attitude that polyneuritis with double facial paralysis occurs with sufficient frequency and regularity to be considered as a syndrome. The unconscious relationship previously referred to is for future pathologic demonstration. In the experience of one who has seen many cases of poliomyelitis and of encephalitis, it is rare to find a case with double facial involvement and numbness and weakness of the extremities with altered reflexes. The clinical course and clinical expression are noteworthy. After a dull, griplike onset, there comes a latent period of several days, followed by a rather rapid development of weakness and numbness of the extremities with later facial involvement. The development is not of a definite norm. The clinical course may vary, but the essentials are always present. The findings in the spinal fluid are interesting. The cell count may be normal or may be increased, and the protein content may be normal or greatly increased; there may be a dissociation between the cell count and the albumin content, that is, a normal cell count with a very high protein content. In Viets' case there was only 1 cell, and the total protein was 348 mg. There may be great differences in the total protein in the cisternal fluid and in the lumbar fluid in the same case. In considering Landry's paralysis, Walton many years ago stated that there may be a neuritic involvement, and that Landry's paralysis would cease to be a distinct entity. Dr. E. W. Taylor, in 1900, under the title "Landry's Paralysis: Remarks on Classification," detailed a case like the ones being considered; he used this case as a text against the conception of Landry's paralysis as a distinct entity. It is interesting to hear Dr. Kubik describe the pathologic changes as distinct from the common poliomyelitic picture. To the clinical syndrome of polyneuritis with facial diplegia is added Dr. Kubik's excellent pathologic study.

TWO PSYCHIATRIC CASES. DR. MARIANNA TAYLOR.

CASE 1.—F. C., a girl, aged 19, single, was in the Massachusetts General Hospital for observation from Oct. 26 to Nov. 18, 1931. She complained of:

1. Obstinate constipation for three years, with one bowel movement a week as a rule, and three bowel movements in the preceding five weeks. Occasionally

she had what she called "imaginary movements," when she felt as though the bowels were moving; but after the sensation was over she found that nothing had happened. She had a feeling of special well-being rather than malaise when constipated. When the bowels did move, she felt indisposed and depressed. Strong cathartics and enemas of milk and molasses were unavailing.

2. Infrequent urination, never oftener than once in twenty-four hours. Once she went for fifty-six hours without voiding. At the time of admission she was voiding once in thirty-six hours.

3. Occasional vertigo, spots before the eyes and headache for about a year.

4. An attack of severe vertigo and occipital headache while shopping two weeks before admission. She felt as though something had snapped in her head. One-half hour later, she found herself in a different store with no recollection of having gone there, and she remembered nothing else of what had happened in the meantime. The head then felt numb, as though it had gone to sleep. One week previously, there had been a single attack of headache and nausea with vertigo followed by vomiting.

The family history was essentially unimportant medically; one cousin was said to be an invalid because of constipation.

The personal history was unimportant medically. At 7, the patient had fallen, striking her head on a concrete floor, and had been unconscious for several hours. At 13, she had sustained a trauma to the vulva from a fall on a bicycle.

Physical examination gave essentially negative results throughout. X-ray plates of the skull, chest, teeth and gastro-intestinal tract showed nothing abnormal. The white blood cells numbered 11,600.

It was the consensus that this case was probably psychogenic.

Psychotherapy was explained to the patient, and her reaction showed that she felt a need to discuss certain problems and believed that this would help her. A review of her life was undertaken. She stated that she was the youngest of three children, in a family in which all members were very close to one another and at the same time especially reticent. She stressed the extreme reticence and reserve of both father and mother. She had been a delicate baby; she weighed 5 pounds (2.3 Kg.) at birth and had had a difficulty in feeding. From earliest childhood she was very sensitive, and her feelings were easily hurt. She was not a "good mixer." Hard lessons in school always appalled her.

The patient's love of babies had been especially striking. She would wheel around the babies in the neighborhood in preference to anything else for recreation; she would do this rather than play with other children. She had received no sex information from her mother, and although she always had much curiosity about it she never asked questions. She thought that a woman with a goiter was pregnant, and that the goiter was the baby's head. She was never told about menstruation and was much terrified by her first menstrual period.

She had gone to school where the chaperoning was very strict. She had been engaged for a short time, but had broken it off because of a difference in religion of which her family disapproved. She did not feel especially unhappy about it. Her goal was to take state-supported children to board rather than to marry and have children of her own. She seemed very childlike and demure, with not much interest in companions of the opposite sex; she was given to day dreams and did not mingle adequately with persons of either sex. She was especially interested in the unmarried mother and was moved to tears when consigned to a ward for such mothers while she was for a short time in training to be a nurse. Her interest was associated with a painful chapter in her family history; a relative had had an illegitimate pregnancy and had given the child for adoption. The patient still dwells on this with great emotion and a deep sense of loss. She keeps this baby's picture, and the baby looms large in her fantasy life.

The patient wrote an autobiography and talked freely, bringing up family and personal problems. Her dreams were of snakes, of babies and like symbols. After the second or third psychiatric interview she began to have normal bowel movements. Her own observations about herself are of interest.

She said: "While at Northfield two years ago another girl and I wondered if we were sexless." Again she volunteered: "I have always cared for babies more than anything. That is the difficulty more than anything else. I have always felt this constipation was connected with it, and that if only I had a child I'd be benefited."

The patient's constipation dates back three years, when the family went through the painful experience of the illegitimate pregnancy referred to. The patient had seen various physicians because of her constipation and her infrequent micturition. One had told her that she was three-fourths paralyzed and another that if she was not cured by the time she was 30 she would be an invalid for life. These statements naturally alarmed her and preyed on her mind. Her employer volunteered that she believed they were largely responsible for the girl's vertigo and loss of memory when on the shopping tour. Certainly they caused her profound worry.

After a few weeks of intensive psychotherapy the patient's health and mental attitude have been satisfactory. On November 15, the mother telephoned that the patient continued to be in good health. She had had practically no trouble with constipation. There was only one occasion when she had slight difficulty with loss of memory. This occurred some time in the spring after procaine hydrochloride had been administered for the extraction of a tooth. The patient went to see Dr. Pinckney, a house officer, who told her that in all probability the condition was due to the procaine hydrochloride. Last summer, the patient took care of a girl, aged 9. The family of the child was pleased with the patient's services. This autumn the patient again secured a position as children's nurse. The patient is happy.

CASE 2.—N. A., a man, aged 31, single, had been to eye and throat clinics for slight conjunctivitis and slight sinusitis. He had been treated in another hospital for a duodenal ulcer in 1927. He was referred to the neurologic department at his own request. He was worried about his head, and said: "When I try to play my accordion before any one except the teacher, I get rattled and everything goes blank." The patient was born in Glasgow, Scotland, of country people and was the youngest of seven children. The father had had gastric ulcers all the boy's early life; he died when the patient was 10. He was morose, dour, stern and repressive, and was out of work most of the time because of ill health. The mother was kind, hard working and inclined to spoil the patient.

The patient had always been shy. He felt a difference between himself and other children. He never had courage to mingle with the rest, although he wanted to. He resented the family poverty and humble social status, the cast off, hand-me-down clothes, etc. His adjustment to school work was good. He went to day school until he was 14 and two years to night school. He could not get on with men at work. If they were successful he grew suspicious of them. He has a money complex. He has lost money and is employed only three days a week in an electrical machine shop.

He says that he has "inherited" his father's ulcers. He fears cancer and has been under treatment at the Peter Bent Brigham Hospital, and expects to be operated on at some later date; his first visit to that hospital was in February, 1927, and the last in March, 1931. Four roentgenograms were positive for ulcer. On Feb. 11, 1932, no ulcer was found here.

On admission he complained of inability to mingle socially, of being a great arguer and of inability to play the accordion in public. He gave a history of a drab childhood, with many grievances against the family. The father and older brother bossed him. Nervous indigestion was a family reaction. He wrote a long and intimate autobiography to which he gave much time and interest. He analyzed his siblings with keen insight, but always tended to stress each one's weakest spots. Much rancor was shown. All the family were hypercritical. The patient was teased about being thin and having a small face; he took this seriously. He was a passive, inhibited child, with a tremendous feeling of inferiority. He never

thought for himself, never acted independently and never had any confidence in himself. He day dreamed of grand exploits and prowess, of a beautiful girl, and like advantages, but he never made a good adjustment. He was easily shocked and overnice, and was curious and interested in regard to sex. He was highly auto-erotic, with much sense of guilt and sin. He was too introverted and self-centered ever to have been greatly stirred emotionally, except in day dreams. He had had casual sexual episodes, but no romance. He had many fears. His health has been a continual preoccupation. He was told that his stomach would be a life problem. He has been fearful of failure socially and economically and has little sense of security along any line, except a false bolstering up by compensatory grandiose illusions which are but passing means of relief.

He said: "I am doubtful about my energy and I am quite sure it depends on how my stomach is feeling. I have wasted a lot of energy in hating people." Concerning the accordion he said: "I can almost feel some force holding my fingers back." Concerning men he said: "Something at times tells me to be careful as though I might get hurt either physically or I might suffer from hurt dignity."

The patient detailed many dreams. Many showed a markedly homosexual coloring. He showed great interest in these dreams, and they brought up many emotional complexes. His insight and cooperation from the first were good.

He reported here for an hour twice a week for about two months and then once a week for two more months. He was last seen on Nov. 10, 1932, about a year after his first visit, when he reported that he was "making a much better adjustment than I could have hoped for." His church affiliation and accordion playing were going well, on the whole. His attitude toward other people seemed more agreeable and more tolerant. Digestive symptoms were absent, and x-ray pictures taken in February were normal.

OUTPATIENTS IN THE PSYCHIATRIC SERVICE. DR. MARGARET R. ANTHONISEN.

My purpose is to give a sort of cross-section of the stream of outpatients seen in our division of the psychiatric clinic. A psychologist, two social workers and I, as psychiatrist, work as a unit with younger patients, i. e., those ranging from 8 or 9 up through adolescence. I have selected two short cases to represent two of the major divisions in the arbitrary classification of our material—as it stands now at the end of our first year's work. These two cases were chosen because we have been able to work long enough with them to attain a measure of understanding in each. The dispensary population is a floating one. The frequent return visits required in psychiatric treatment are too taxing for many patients; even the carfare may be an important deterrent.

Our largest group of cases is that of the part-personality disorder of the neurotic type. Physical symptoms and complaints take the patients to various other clinics from which they are referred or transferred to us.

CASE 1.—James, a boy, aged 13, in junior high school, had vomited after meals for a year and a half. He was sent to us after the medical clinic had found no organic cause. He was about 1½ inches (3.77 cm.) shorter than the average height for his age and 20 pounds (9 Kg.) below the average tabulated weight. He slept poorly; he seemed to be worried and unhappy, and he spent an unusually long time in saying prayers.

The vomiting, poor sleep, obvious worry and excessive prayers disappeared after his third visit to the clinic. He had had a hyperopia corrected. The regimen of rest and restriction at home was changed; he had breakfast alone to prevent arguments with a younger, though physically superior brother. Through the psychiatrist he had been informed concerning the following facts, which he himself brought up. He often vomited when he was excited, as before examinations in school, just as he had seen his mother do when she was excited. The persistent vomiting began when he saw his mother's morning sickness of pregnancy. He said that he did not know she was pregnant, but he was worried about her health

and her monthly visits to the hospital, being afraid that she would be kept there. When she went to the hospital for delivery he was badly disturbed, could not sleep all night, and afterward was in a muddle as to how the baby came. Coincident with and succeeding this was a persistent pondering of the lively sex talk he heard from a group of classmates. Though he could not keep thoughts of this out of his mind, he was disgusted by them.

Even months after the vomiting has stopped the patient has gained little weight. Further examination in the medical clinic has found no explanation. Careful carrying out of dietary advice has not helped. Now his outstanding trouble is his reaction to physical disability. He makes handicaps in competition his overt reason for concern about his size and strength. In a community where "big guys" and "he-men" are the important figures, with a younger brother who is already bigger and stronger than he, and with a family commiserating over his poor health, this boy has had a hard world to struggle against. So far we have no lead as to an inner evaluation of his smallness and weakness in relation to his sexual worries.

As it is working out, he is now finding fields other than that of physical prowess in which to excel. His interest and responsiveness keep him in pleasant rapport with his peers. His parents are utilizing their understanding of his needs by accepting his size as a matter of fact, and encouraging and unobstrusively supporting him in his new interests rather than emphasizing his disability by solicitous concern. We continue to see this child with the hope of helping him further with conflicts now represented by dreams of criminals. To date he has come to see us only twelve times.

A second large division of our cases is that of the behavior problem.

CASE 2.—Charlotte, aged 12, was expelled from junior high school because restlessness and showing off made her unmanageable. Her behavior was so loud and erratic that she was considered psychotic by friends and neighbors, some of whom told her seriously that she ought to be in the "crazy house."

This patient is the only child of elderly Jewish parents, born long after they had given up the hope of having children. In their great affection and devotion they provided few or no training disciplines; they have allowed her to want for nothing they could supply. Her babyhood habits were retained for a relatively long time, while her physical development has been rather accelerated. Now, at the age of 12, her physique is that of a well developed but small woman, with unusually large breasts. Adolescent sex interest developed early and was uninhibited; she seemed to seek outlet for a curiosity which her earlier life as an isolated only child had given no opportunity of satisfying. In the latter part of her tenth year she went in for a good deal of mutual exhibitionistic sex play and discussion with some boys who were her age chronologically, but physiologically much younger. She reacted with shame, resentment and anger at their teasing about her pubic hair and breast development. "They made me think it was horrid to be a girl" is her statement. When, at 11 years and 5 months, the menstrual periods began, she was outspokenly resentful.

The patient's social adjustment had always been precarious, because she demanded the same place among her peers as she was used to having in her home—this she persistently sought by aggression and boasting. Girl friends who played with dolls completely alienated this child, who was collecting pictures of actors, reading and retailing love stories and using rouge, powder and lipstick indiscriminately.

By the time the patient was singing and dancing in the aisles of the schoolroom and broadcasting the tale that she was going to be the beautiful actress in "Tarzan of the Apes," she not only was ostracized, but was seriously criticized and gossiped about. Her parents, who had previously arranged the world to suit her, not only could do nothing about it, but were threatening in their disapproval. She turned on them in anger, kept to herself and made extensive plans to go to Hawaii, where she would wear a grass skirt and dance on the white sands in the moonlight. She proceeded to make the grass skirt, to read all the travel

advertisements for Hawaii and to go to all the movies of the "Trader Horn" variety, i. e., with cave men and jungle erotics and the beautiful white woman theme.

Social treatment in this case was of the more immediate importance. In having this child, the veritable apple of their eye, in disfavor with community and school, the parents were threatened in their status as individuals and as a family. Their one idea was to have us officially declare her "not insane," so that they might force the school to take her back. The social worker found it difficult to deal with the parents, but she persuaded them to work out a plan whereby the child is being tutored at home and given an opportunity for the outlet of energy and for orienting experience with older girls in swimming and dancing classes. Individual work with this patient has consisted in fifteen visits in which she has been allowed to pour out her angers and enthusiams while meeting with an attentive but neutral listener. We have now arrived at the stage where the patient does not bother to tell what her mother has told her to tell me, but finishes each interview with, "Now what will I tell my mother I told you today?" We had started with the patient convinced by her mother that I was going to send her to a reform school.

While the patient presents a behavior problem, there is obviously more in it than a clash with the outside world. Her resentment and protest against her sexuality, as she conceives it at present, holds rich possibility for intrapsychic difficulties.

A fairly large group of our cases are classified under the general heading of educational problems. This includes the variations in intellectual endowment and their consequences, the reading disabilities and the problems of vocational guidance. I shall not illustrate from this field, which belongs more to Dr. Young, the psychologist, than to me.

We have a small group of young psychotic patients. Among them is an occasional circumscribed depression, about which we feel fairly clear. The larger number of the cases, however, I hesitate at present to label with any more definite name than "adolescent psychosis." When we first see these patients, they have not been sick long. In cases in which the symptoms have come on slowly, the patients are brought to use because of hypochondriacal physical complaints, because of failure in school through difficulties in concentration or because of changes in personality in the direction of withdrawal, such as wanting to stay in bed and not going out with friends. In cases in which the symptoms come on quickly, we usually see a confusion episode or a short-lived catatonic picture.

CASE 3.—A tall, slim girl, aged 13, came home from school one day "in a daze." For a week she sat about, stared into space, did not speak and wanted to sleep a lot. Gradually she came back to her usual behavior, and then told us that the girls at school talked about something that bothered her terribly. She has now completely forgotten what it was, but at the time she had a bad headache, something snapped in her head, and God talked to her, telling her to get well.

CASE 4.—A girl, aged 15, the eldest of five children of a widow, had been turned down on her first attempt to get a job. After seeing a movie contrasting wealth and poverty and with the death of the mother in the poor-home, she felt dazed inside, tense and jumpy and could not stop talking. She became confused as to the time and the usual events of the family's routine. She felt strange and queer, and wondered whether she would lose her mind and become like her uncle. (He has been a patient with dementia praecox in a state hospital for ten years.) Then she accused her sisters of saying that she would lose her mind. She had three weeks of feeling tired, having neither energy nor attention for anything; she seemed absent minded and not to care. Then gradually she came back to her more usual behavior and finished her school year.

CASE 5.—A high school boy, aged 17, is the eldest child and only son of an Armenian family of seven. His father is crippled with arthritis. The boy tries to prevent the father's business partner, who is his uncle, from cheating them. They have hard financial going, and the boy knows his position relative to the family responsibility. One day while at work he heard the groans and cries of a sick

man. He became excited, thought that the man was being killed, became "foggy in his head" and went home in a "misty way"; it all seemed like a dream. For a week he stayed in bed; he slept some of the time, and spent the rest in fantasies of inventions he would make and of marrying the girl to whom he says he has not the courage to speak. After the week this boy returned to school and to work, but two months later he had a similar attack.

Four months after the onset, this boy had stopped going about with other boys and was reading books on mechanics instead. He spoke little to any one, and when he did his attitude and speech were peculiarly stiff and formal. He expressed some vague suspicions. A year after the onset, however, he was still holding a job.

These cases are difficult to work with in a dispensary. The patients never come to us; they are always brought, usually by an anxious parent. They are not interested in returning for a series of visits and can rarely be persuaded to do so. One hesitates before attempting to explore in acute cases, knowing that precipitation of another acute attack is likely; such an attack in a patient outside a hospital is a serious responsibility. Such cases are well known in the literature on schizophrenia, but usually they are viewed in retrospect. I question whether chronic schizophrenic illnesses develop in all of the patients. If there is a therapeutic approach to schizophrenia it would seem that these cases present a good opportunity.

BULBAR POLIOMYELITIS. DR. NEIL L. CRONE.

The cases of a group of twenty-four patients with acute poliomyelitis who were treated in the Drinker respirator were reviewed. The cases were divided into three groups, dependent on the primary cause of respiratory failure: (1) involvement of the respiratory muscles, (2) involvement of the bulbar "centers" and (3) involvement of both mechanisms.

In the first group there were nine cases. Five patients died and four survived. Two of the four survivors, who had been followed up for two years, were invalids confined to bed. Of the other two, who had been followed up for one year, one was completely paralyzed in the legs, arms and trunk and was confined to bed while the other showed sufficient recovery to justify the hope that she may walk with the aid of braces and crutches. This is the group in which the respirator could theoretically be expected to be of most value.

In the second group there were ten cases. All were fatal. Reasons were brought forward to demonstrate that the respirator may not be expected to aid in such cases. In the cases of bulbar involvement the most unfavorable signs are: (1) a rapid pulse; (2) excessive mucus; (3) vomiting after the prodromal period; (4) short, gasping inspiratory efforts, and (5) persistence of a high content of sugar in the spinal fluid.

In the third group there were five cases. Of these, three were fatal. One of the survivors had little or no involvement of the medulla, but presented a nearly complete paralysis of the arms and legs. He wore braces after two years, and had almost no use of his arms. The second survivor had been followed up for only two and one-half months. He also had little and temporary involvement of the cranial nerves. He had extensive paralysis of the arms, legs and trunk, and spent all night and two hours during the day in the machine. It was thought that the respiratory difficulty in both these cases was due to intercostal and diaphragmatic paresis and not to bulbar involvement.

Of twenty-four patients treated in the Drinker respirator, eighteen died. Of the six who survived, some were permanently paralyzed. In two patients who were in the respirator for the longest periods, extreme dilatation of the ureters and renal pelves developed, probably as a result of the action of gravity on the ureters as they passed over the pelvic brim. It is believed in poliomyelitis the use of the respirator is always justified for symptomatic relief, and that most is to be hoped for in cases of intercostal and diaphragmatic paralysis. The most unfavorable type is that in which the respiratory difficulty is due to bulbar involvement.

MULTIPLE TUMORS OF THE BRAIN. DR. JOHN S. HODGSON.

CASE 1.—The patient, a woman, aged 23, gave a history of dizziness, headache, tinnitus in the left ear and some deafness for three years. Lately, there had been vomiting, numbness of the left side of the face and numb feelings in the left hand and the left side of the chest. When she entered the hospital, examination revealed numbness of the left side of the face and eye, a little nystagmus, choking of the disks of 1 diopter, unsteadiness in the Romberg position and staggering gait, while roentgenograms suggested involvement of the internal auditory meatus and canal as by acoustic neuroma. This, however, was an unusual case in that there was deafness not only of the left, but also of the right ear. We planned to operate and expected to find a neuroma on each side. Preceding the first operation, there was shown, by combined lumbar and ventricular puncture, an increase of intracranial pressure to 300. There was a change of protein in the lumbar field to 200 mg. The ventricular fluid was normal.

A left pontile tumor, about the size of an olive, was found. This rather unexpectedly and suddenly came away entirely free. It was hard and dry and looked grossly like an acoustic neuroma. The fact that it came out so easily was against this, however. About a month later, I attempted to explore the right side. This was extremely difficult. The pressure was high, and because of the difficulty of working on that side I was obliged to stop. The patient died six days later.

At autopsy two other tumors were found on the left side, each involving the seventh and eighth nerves. There was no tumor pressing on the fifth nerve. On the right side, a large tumor involved the eighth nerve, and above the tentorium there was a large tumor of a similar sort. Just posterior to that on the undersurface of the dura was another tumor of fair size. There was a small tumor involving the choroid plexus. Several tumors involved the cervical and thoracic posterior roots. These proved to be neurofibromas, but were in the same location in which acoustic neuromas might be found. We were dealing with a type of tumor favorable for operation, but the multiplicity of the growths rendered the situation hopeless.

CASE 2.—A man, who had been tabetic for a long time, and who for about a year had been having tabetic gastric and rectal crises, had chordotomy performed at the level of the first dorsal vertebra. There was immediate relief from pain in both regions. The relief has been complete so far, about one year, except for the customary pain at the level of the chordotomy. There is loss of painful sensation, but other types are preserved.

Book Reviews

Maladies du système nerveux. By Henri Claude. Second edition. Volumes 1 and 2. Price, 190 francs. Pp. 1,578, with 277 illustrations. Paris: J. B. Baillière et fils, 1931.

This excellent French textbook is encyclopedic in scope. The sections on morbid anatomy, if grouped together, would form a veritable treatise on neuropathology, while the chapters on signs and diagnosis constitute a practical handbook of neurologic examination. The book is both informative and well written, and the review of the history of knowledge of the disease makes an interesting preface to each chapter. Following the first ninety pages, which are devoted to general neuropathology, is a section on physiology which outlines the mechanism of hemorrhage, trauma, infection, atrophy and various other agencies as causes of neurologic syndromes. Each part of the brain is reviewed, with a description of its structure, function, pathologic pictures and clinical syndromes.

Cerebral hemorrhage is the disease first presented, the explanation of its pathogenesis being of special interest. The differential diagnosis between apoplexy and other forms of coma is well analyzed. The methods of treatment advocated would seem old fashioned in the United States, stress being placed on the utilization of leeches, mustard plasters and scarifications. During the period immediately following the stroke, Claude suggests calcium chloride, ergot and other hemostatics to discourage further bleeding. An interesting series of paragraphs is devoted to hemorrhage of venous origin. Cerebral softening (the term is limited to infarction) is described not as a static condition but rather as a dynamic one of developing symptomatology; softening of sudden onset is distinguished both clinically and pathologically from cerebral hemorrhage. In the chapter on abscess of the brain, Claude emphasizes the need for extensive opening and complete drainage, preferring them to the paracentesis advocated by Dandy and other American neurosurgeons.

Adequate attention is given to the diagnosis of tumor of the brain. Agreeing with many American neurologists, Claude recognizes ataxia as an occasional frontal lobe symptom, although he does not assign involvement of the frontopontocerebellar tracts as the cause. He advocates lumbar puncture in patients with possible neoplasms, and gives briefly and practically a technic for performing the spinal tap in instances of elevated intracranial pressure. In the spinal fluid, an increase in albumin content without a corresponding leukocytosis is considered suggestive of a tumor of the brain. Although ventriculography is discussed, no mention is made of the encephalogram. Cranial percussion as a means for eliciting local tenderness over a tumor is advised. In doubtful cases, Claude recommends the injection of potassium bromide into the carotid artery for roentgen visualization of the cerebral arterial tree.

A large part of the first volume is devoted to encephalitis. This term is used more broadly than in the United States, for within this classification are included: the tuberculous diseases of the brain, cerebral injuries, Schilder's disease (designated subacute leuko-encephalitis), senile plaques and many other forms of intracranial pathology, in addition, of course, to the hemorrhagic and epidemic types. The latter entity is particularly well presented. The less well known sequelae, such as chorea, singultus, polydipsia and torsion spasm, receive full discussion. The useful term "bradypsyche" is devised to indicate the slowing of all mental processes often observed after encephalitis. For the treatment of acute epidemic encephalitis, Claude recommends methenamine, colloidal metals, salicylates, hot baths and convalescent serum.

Syphilis of the nervous system, in all of its forms, receives adequate attention in these volumes. Mercury, bismuth and iodides are praised highly as antisyphilitic

remedies; the author, however, is less certain of arsenical therapy, fearing a Herxheimer reaction. For dementia paralytica the malarial treatment is recognized and recommended.

In the diagnosis of meningococcic meningitis, Claude attaches much importance to the chloride content of the spinal fluid. He unqualifiedly recommends serum therapy, administering the antitoxin intravenously as well as intraspinally.

The postconcussion syndromes are described under the designation "traumatic meningo-encephalitis." Cystic arachnitis (pseudotumor), until recently neglected in the American literature, is adequately presented. Like most American observers, Claude refuses to classify epilepsy as a disease entity. He is not inclined to attach much importance to hereditary factors in the development of the convulsive states. As treatment he recommends phenobarbital and bromides, mentioning with faint approval the ketogenic diet. Although dehydration as a method of treatment is not listed, the author does refer to the increase commonly noted in the spinal fluid pressure in epileptic patients. Cataplexy is described in the chapter devoted to the convulsive states.

Chorea and paralysis agitans are fully discussed, including the so-called "senile chorea," which seems to belong more properly to the parkinsonian group. For chorea, Claude suggests hydrotherapy, salicylates and arsenic, being especially enthusiastic about the latter. In the therapy of paralysis agitans he stresses stramonium, which has only recently received attention from American and British authors. The section on aphasia is of great interest; a detailed, profound and theoretical analysis of language mechanisms forms the first part of this chapter. An ingenious schedule for the examination and classification of patients with this defect is included.

To the cerebellum, which is considered exclusively a motor organ, are devoted forty pages in the first volume. Decerebrate rigidity receives scholarly treatment.

The second volume deals with the spinal cord. In a careful analysis of spinal concussion, minute hemorrhages within the cord are considered causal. Herpes zoster receives a perhaps disproportionate amount of space, more than eighteen pages being assigned to this disease. Poliomyelitis is thoroughly reviewed. Although highly recommended, the serum is not relied on, and in very early cases a plaster cast is suggested. For treatment in both multiple sclerosis and syringomyelia, roentgen rays are suggested. The last part of the second volume is devoted to the neuroses. Although the point of view is refreshing, the classification will probably prove bewildering to American neurologists. Claude divides the neuroses into five groups: reflex disorders, emotional neuroses, hysteria, catatonia and asthenia. The last corresponds closely to the American concept, neurasthenia. Catatonia represents that form of dementia praecox, the author agreeing that this group should be so reclassified. The reflex disorders are, to a large extent, inclusive of the vasomotor neuroses. To prevent the development of functional nervous conditions, Claude offers some sound advice: avoid metaphysical, mystic and esthetic experiences and teachings which might contribute to a more or less hysterical attitude toward life; temper imagery and day dreaming with reason; avoid bad examples. In the active treatment of the fully developed psychoneurosis, Claude suggests: (1) suppress precipitating causes; (2) isolate the patient; (3) avoid harmful suggestion; (4) supply desirable and affirmative suggestion; (5) persuade by rationalization.

Although its simplicity of style and convenience of arrangement make it a suitable reference book for the student or general practitioner, Claude's volumes are written essentially for the neurologic specialist. Unlike most American and British texts, which make brevity an issue and generalizations a practice, these volumes deal extensively with etiology, pathology and symptomatology, and practically, yet fully, with therapy. It is unfortunate that the absence of an English translation denies to American and British physicians access to this most valuable work.

Practice of Surgery: Clinical, Diagnostic, Operative, Postoperative. Edited by Dean Lewis, M.D., Sc.D. Volume 12. Pp. 1,149. Hagerstown, Md.: W. F. Prior Company, Inc., 1932.

This volume is of particular interest to neurologists and surgeons, for the bulk of the book is of neurologic interest. The first chapter, of 682 pages, is by Dandy. After a short introduction, he presents the diagnosis of neurologic conditions. The best part is undoubtedly the discussion of encephalography, ventricular estimation, encephalography with iodized oil and arterial encephalography. It would be easy to find fault with the discussion of cerebral localization. Some of the statements are too dogmatic. However, looking at it from the surgical standpoint, they will do. On the other hand, the neurologist would find it difficult to accept many of the statements made by the author, not only in this particular chapter but throughout the entire discussion, for obviously there is a wide division between the neurosurgeon, who looks at neurologic symptoms purely from the operative standpoint, and the neurologist, who should and does know more neurology. However that may be, the surgical aspects are beautifully done. It is possible to disagree with the author in the methods that he employs, for example, the suboccipital approach for sectioning the sensory root of the fifth nerve, or the boldness with which he removes parts of the brain. Nevertheless, as a clearcut and excellent presentation of the surgical methods of treatment of neurologic conditions, nothing but praise can be offered.

Chapter 2 is by Peet, who, in about 100 pages, discusses the cranial nerves. This is largely a repetition of what has been presented by Dandy. For example, in the discussion of trigeminal neuralgia, the author gives his operative technic, which is largely repetition. It is a pity that this should occur, for it adds to the cost of the book.

The third and fourth chapters are by Mixter on the spinal column and spinal cord, which are discussed in 127 pages, and fracture and dislocation of the spine in 27 pages. These are well presented. The rest of the chapters are not of neurologic interest, excepting chapter 5, on the blood vascular system, which was not completed at the time of the review.

Such books as these suffer from the fact that there is no collective manner of presentation and there is frequent repetition. No system is as good as an individual treatise.

Hirnpathologische Beiträge. By Prof. K. Schaffer and Prof. D. Miskolczy. Volume 11. Pp. 400. Budapest, Hungary: K. Schaffer, 1932.

This volume is the eleventh in the series of contributions from Professor Schaffer's clinic in Budapest, and the first in collaboration with Professor Miskolczy. The volume is divided into three parts: normal histologic studies, histopathologic contributions and clinical studies. The studies cover a wide range of subjects, including studies on the spinocerebellar pathways, microglia, pyramidal tract, tabes dorsalis, chorea, Wilson's disease, rabies, amaurotic idiocy, suboccipital puncture, muscle atrophy and catatonia. The studies made under the direction of Schaffer and Miskolczy attain a high degree of merit. The volume is a fine contribution, and the preceptors are to be congratulated on its excellence.

Hirnpathologische Beiträge. By Prof. K. Schaffer and Prof. D. Miskolczy. Volume 12. Pp. 400. Budapest, Hungary: K. Schaffer, 1932.

This twelfth volume of investigations from the clinics and laboratories of Prof. K. Schaffer in Budapest and Prof. D. Miskolczy in Szeged is dedicated to Prof. Max Nonne.

The volume is a compilation of the works published during 1932, and is divided into six portions dealing with: the anatomy and physiology of the nervous system, the pathology of neuro-endogenous diseases, the pathology of exogenous diseases and general works. Under these headings are discussed many subjects, such as: the cerebellar portion of the pyramidal tract, the muscle atrophies, amyotrophic lateral sclerosis, amaurotic family idiocy, Wilson's disease, hemiballism, juvenile dementia paralytica, exophthalmic goiter and other subjects.

The volume is a tribute to the zeal and energy of the directors and their co-workers in the institutes and forms a fitting tribute as well to Professor Nonne. The directors are to be congratulated on the number and quality of the investigations prosecuted during the course of a year.

Das Rechtsgefühl in Justiz und Politik. By A. E. Hoche. Price, 5.80 marks. Pp. 102. Berlin: Julius Springer, 1932.

In this little book the author, one of the veteran leaders of German psychiatry, discusses the status and significance of the sense of justice. "Sense of justice" is for him an elementary phenomenon which cannot be analyzed further. It is "an emotion that cannot be compared with anything else, which is aroused through contact with facts and presentations of juridical nature." Its psychologic origin is obscure. It appears late in human history, and the very expression "sense of justice" the author has been able to trace back only a hundred and fifty years. The sense of justice is developed differently in different persons. It is stronger in men than in women. It is present in children. The author discusses the sense of justice as it enters into everyday life, the administration of justice and politics. His examples are drawn from recent German history. Finally, he takes up the question of the so-called "querulants," both normal and abnormal, who indulge in long and repeated legal battles. The discussions throughout are somewhat subjective, and the attitude of the author is more righteous than analytic. The book is written in excellent style.

Radiologic Maxims. By Harold Swanberg, B.Sc., M.D., F.A.C.P., Editor of The Radiological Review, Quincy, Ill. With a forward by Henry Schmitz, A.M., M.D., LL.D., F.A.C.S., Professor of Gynecology and Head of the Department, Loyola University School of Medicine. Cloth. Price, $1.50. Pp. 126. Quincy, Ill.: Radiological Review Publishing Company, 1932.

This book consists of 126 pages of clinical and roentgenologic observations collected from the literature, boiled down to brief statements of facts that have been accepted by practically all leading radiologists and clinicians. It therefore gives the busy clinician, in brief form, an idea of what help he may expect from radiology in diagnosis or in the treatment of patients. These facts (or "Maxims") are arranged under the title of the various specialties, and are also indexed as individual titles, so that the book is of value not only to other specialists but also to radiologists. The statements made by leading clinicians as to the value of radiology will be helpful to all.

Aus meinem Leben und Denken. By Albert Schweitzer. Price, 6.50 marks. Pp. 211. Leipzig: Felix Meiner, 1932.

The psychiatrist who usually has to occupy himself with the life histories of persons who are handicapped and frustrated in some way or other may find not only distraction but also a great deal of instruction in this book. It is the autobiography of a remarkably full and successful life. Albert Schweitzer, the Alsatian philosopher, has achieved distinction in the most diverse fields. His critical research on the Bible is considered authoritative. He is a renowned concert organist. He is a widely consulted authority on the construction of organs. He is a pioneer in missionary medicine. (He founded a hospital in the Congo.) As a philosopher and critic of modern civilization, he is an outstanding figure. To the psychiatrist, Schweitzer is known as the author of a psychiatric paper on the psychopathology of the life of Jesus, in which he has given a critical survey of the writings of de Loosten, William Hirsch and Binet-Sanglé. In this autobiography, Schweitzer gives in simple and clear language an account of his life and of the chief contents of his books. There are a number of photographs depicting chiefly his hospital at Lambarene.

Behavior Aspects of Child Conduct. By Esther Loring Richards, B.A., M.D., D.Sc. Price, $2.50. Pp. 288. New York: The Macmillan Company, 1932.

Of the many books on this subject that have been written chiefly for the layman, few are worthy of consideration. This book is an exception. To begin with, the study was undertaken in a clinic in which the work is uniformly of high excellence. The behavior aspects of child conduct are of the utmost importance, and throughout the author emphasizes the need for a comprehensive study of this most intricate problem from many angles. As was brought out in the recent White House Conference on Child Welfare, knowledge of behavior aspects of children is in its infancy. The author presents the subject with the broad comprehension of the many difficulties and pitfalls which beset the subject. The case illustrations that are used throughout the work illustrate well the various aspects of the problem. The book can be recommended both to the layman and to the physician.

Psychodiagnostik. By Hermann Rorschach. Volumes 1 and 2. Second edition, revised and enlarged. Price, $3.60. Pp. 230. Bern: Hans Huber, 1932.

This is a second edition, edited by W. Morgenthaler, of Rorschach's now well known book. It includes also a paper by Rorschach, which appeared first in 1923, on the evaluation of the test. The bibliography covers all the publications of Rorschach and the chief literature on the Rorschach test. The pictures used in the Rorschach test are supplied under separate cover, making up the second volume. They are mounted on stiff boards and are thus in a practical form for use. The printing and the make-up of both the book and the pictures are excellent. A brief but adequate description of the technic of the Rorschach test can be found in a recent article in the ARCHIVES by Frederic Wertham and Manfred Bleuler (**28**:52 [July] 1932). The Rorschach test has assumed sufficient importance, however, to warrant an English translation of this volume. It is to be hoped that it will eventually be available in such a translation.

The Science of Character. By Ludwig Klages. Translated from the fifth and sixth German editions by W. H. Johnston. Price, $3.10. Pp. 308. Cambridge, Mass.: Sci-Art Publishers, 1932.

This volume is the American edition of the English translation of Klages' "Grundlagen der Charakterkunde." Attention has been drawn to this translation and the contents of the book have been fully discussed by Wertham in a previous issue of the ARCHIVES (**24**:381 [Aug.] 1930). The translator has had a Herculean task and has solved it as well as such a task can be solved. Since Klages uses many terms in a special, unusual sense, it is inevitable that the translation of terms is at times somewhat arbitrary. In view of the influence of Klages on psychopathology, the present translation should be welcome to neuropsychiatrists.

Allgemeine Neurosenlehre auf psychoanalytischer Grundlage. By Hermann Nunberg. Price, 12.50 marks. Pp. 320. Bern: Hans Huber, 1932.

The high recommendation which Freud has given to this volume in a brief preface is well justified. The author has undertaken to present the general doctrine of neuroses according to psychoanalytic theories. The presentation includes the older psychoanalytic doctrines as well as the more recent advances, so far as the author regards them as well established. Thus the subject matter forms an organic whole. The author has drawn on his personal experience as well as on the literature and has woven in his own original ideas, especially in the discussion of adaptation to reality, guilt feelings and what he calls "the synthesis of the ego." The book is clearly written and contains a number of brief well chosen examples of cases. There are a relatively short bibliography and an excellent index.